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Document de Travail
Working Paper
2016-22

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# Post-reorganization survival: a semi-parametric and non-parametric analysis of firm characteristics

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**Abstract**

This paper aims at bringing evidence on firm survival after bankruptcy. Instead of considering survival as a binary variable we take into account the duration of the reorganization procedure. We follow a sample of French firms throughout their restructuring process and document factors influencing the reorganization outcome. Based on the existing theoretical and empirical literature on the link between firm ownership structure and performance, we particularly focus on the influence of firm affiliation to a business group and business groups' characteristics. Using a Cox proportional hazards model and a Random Forests model, we find that firm structural and financial characteristics have a strong power to explain survival at different time horizons, however, very few of firm financial characteristics used previously for bankruptcy prediction are useful for predicting the final outcome of reorganization once a reorganization plan is voted. In addition, we show that firm ownership structure proxied by firm affiliation to a business group and business group characteristics has no significant influence on the outcome and duration of reorganization.

**Keywords:** reorganization, bankruptcy, survival, business groups, Cox model, Random Forests.

**JEL classification:** G33, K20, C14.

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## Introduction

Bankruptcy is often analyzed as a discrete event, ignoring what happens after the moment firm enters a bankruptcy procedure. Given the number of actors involved in the process, analyzing survival of bankrupt firms is crucial for the economy as a whole. In this regard, reorganization through the court is designed to be an efficient tool for resolving financial distress of insolvent firms. Firms under reorganization are given the opportunity to restructure their assets, liabilities and other obligations under a court appointed trustee. A reorganization plan is expected to be agreed on with the aim of providing firms, the possibility to return to normal business operations. However, many reorganized firms fail to achieve this ultimate goal, ending up in a liquidation procedure, halfway to success.

Previous research related to post-bankruptcy inspired by the Law and Economics approach has been largely concerned by debating the merits of court supervised restructuring procedures and exploring the factors that are crucial to its success. Beyond the success issue of reorganization, the post-reorganization performance of emerging firms has captured the attention of several scholars. Both dimensions are associated to different factors which encompass the characteristics of emerging firms (Altman et al., 2009; Denis and Rodgers, 2007; Moulton and Thomas, 1993), the operating environment (Maksimovic and Philips, 1998; Platt and Platt, 2002) and the reorganization process (Datta and Iskandar-Datta, 1995; Dawley et al., 2002; Hotchkiss, 1995; Sudarsanam and Lai, 2011).

Our paper falls within the scope of the previously mentioned literature by trying to bring evidence on firm survival after bankruptcy. The purpose of our analysis is not to debate the merits of the reorganization procedure but to assess its capacity to rescue companies once the suspension of payment has been established and reorganization decided. In appearance, this question is a simple one; either the company recovers or it doesn't. The definition of success is, however, not straightforward as pointed out by Warren and Westbrook (2009) according to, choosing the appropriate definition of success, is not a simple task and can be subject to considerable debate. Indeed, their findings show that results can be sensitive to the definition selected. Following LoPucki and Doherty (2015)'s analysis of survival among companies entering a bankruptcy procedure, we contribute to the debate considering the time elapsed during the procedure which is still barely considered in previous research.

We follow a sample of French firms through their restructuring process and document factors that influence the outcome of reorganization. We explore the extent to which the fundamental measures of firm operational, financial structure and performance are related to the duration and outcome of French reorganization filings. The originality of our work is

twofold. First, we account for a number of factors, so far not examined in the literature, although they could have an important impact on the outcome of bankruptcy. In this sense, we focus on the influence of firm ownership structure proxied by affiliation to a business group and account for group characteristics. Studying the influence of firm ownership structure is of major interest since previous theoretical and empirical evidence insist on the link between firms' ownership structure and performance (Berle and Means, 1932; Dewaelheyns and Van Hulle, 2009; Gopalan et al., 2007). Second, we perform two interesting models, rarely combined in previous studies: a non-parametric one, using a Random Forests algorithm and a semi-parametric one using a Cox proportional hazards model.

Random Forests algorithm does not require any formal distributional assumption and is appropriate to tackle complex classification tasks such as the one considered here. The algorithm has been already used to differentiate the factors responsible for bankruptcy (Perminov, 2013; Wang et al., 2014). To our knowledge, our paper is the first to use it for exploring what happens after bankruptcy. Our analysis is complemented with a survival analysis which makes it possible to assess the importance of various covariates in the survival times of individuals through the hazard function (Xu, 2015). The combination of these two methods allows us i) to select the variables that predict firm survival at different time horizons and ii) to assess to what extent these variables contribute to the instantaneous hazard of liquidation of reorganized firms.

Previewing our results, we find that firm structural and financial characteristics have a strong power to explain survival at different time horizons. Nonetheless, our findings suggest that very few of firm financial characteristics used previously for bankruptcy prediction are useful for predicting the final outcome of reorganization once a reorganization plan is voted. This might reveal that more than firm financial characteristics, the reorganization plan, its characteristics and the way it is implemented, might explain the survival of reorganizing firms. Furthermore, firm affiliation to a business group and business group characteristics have no significant influence on the final outcome, suggesting that business groups might be involved in the activity of their affiliates as long as these are still sound.

The investigation in this paper proceeds as follows. In Section 1 we review the theoretical background as well as the related empirical evidence. In Section 2 we provide extensive descriptive statistics for the relevant sample and discuss the methodology. Results and interpretations are given in Section 3.

## 1. Literature review and testable hypotheses

### 1.1. Defining success

Different criteria of success of reorganizing procedures have been used in the literature. A reorganization procedure is often said to be successful if a reorganization plan is confirmed (Jensen, 1992; Warren and Westbrook, 2009). Alternatively, success of the reorganization procedure is related to firm survival. In this line, a successful reorganization is equivalent to the emergence of the firm as a going concern (Morse and Shaw, 1988; Altman et al. 2009; Laitinen, 2011), without any subsequent bankruptcy filing (Platt and Platt, 2002), with a level of total assets at least equal to fifty percent of pre-bankruptcy (Moulton and Thomas, 1993). More broadly, the success of a reorganization procedure is defined according to bankruptcy outcomes, so as, to each outcome of the reorganization process, is associated a level of success. Researchers such as Moulton and Thomas (1993), Daily (1995) and Barniv et al. (2002), classify reorganizations into four categories according to the possible outcomes: successful reorganizations, partially successful reorganizations, mergers or acquisitions and liquidations.

Beyond the success issue of the reorganization process, a handful of researchers focused on post-reorganization survival and performance of bankrupt firms. From that perspective, the success of a reorganization procedure would reflect the extent to which firm performance has improved at the end of the process. Performance measures used previously are manifold. They include firms' operating performance (Denis and Rodgers, 2007; Hotchkiss, 1995; Hotchkiss and Mooradian, 2004), ability to meet cash-flow projections (Alderson and Betker, 1999; Maksimovic and Philips, 1998; McHugh et al. 1998), and stock market performance (Eberhart et al. 1999; Morse and Shaw, 1989; Lee and Cunney, 2004; Jory and Madura, 2010).

To bring more insights into the operating of the French reorganization process, we disregard sample-firms' performance. Instead, we focus on the determinants of both, their probability to emerge from the process at different time horizons, and the determinants of the time spent in reorganization before liquidation. For this end, we rely on the existing literature focusing on the determinants of post-bankruptcy survival and firm performance.

### 1.2. Firm-specific characteristics

Literature identifies a number of firm-specific variables related to the time spent in reorganization, as well as the performance after emerging from reorganization. Variables are often selected based on previous literature related to bankruptcy prediction, assuming that

their might potentially be useful for predicting the final resolution of bankruptcy as well (Barniv et al., 2002). These variables include measures of size, profitability, liquidity, leverage and asset specificity, etc.

Different proxies for firm financial health have been used to assess post-bankruptcy performance and probability of liquidation. In this line, Altman et al. (2009) explore the probability of filing for 'Chapter 22' (i.e. filing a subsequent bankruptcy petition for firms emerging from Chapter 11) with a revised version of the well-known Z'' score prediction model[1]. The new Z" score includes four variables which measure firm levels of liquidity, solvency, profitability and leverage. Using data from the first financial statements following the emergence from Chapter 11, relative to a sample of 86 firms under Chapter 11, Altman et al. (2009) underline that firms filing for a second bankruptcy exhibit higher leverage and lower profitability levels, shortly after emerging the first time.

The relevance of financial ratios for explaining the survival and the time spent under reorganization has been highlighted by other researchers as well. Denis and Rodgers (2007) explore the extent to which fundamental measures of financial structure and performance are related to the duration and outcome of Chapter 11 filings. They find that the pre-filing operating performance is significantly positively related to post-Chapter 11 operating performance. Firm financial structure, proxied by the level of debt is also shown to influence the outcome of bankruptcy. Denis and Rodgers (2007) show that firms with greater pre-filing liability ratios are more likely to reorganize successfully[2]. They argue that firms with higher pre-bankruptcy leverage may be less economically distressed, implying that they are more likely to reorganize than lower leveraged firms. Contrastingly, Dewaelheyns and Van Hulle (2009) assume that the overall level of debt is an indicator of the severity of the financial difficulties of filing firms. Their findings show that leverage and the duration of the process are positively related, suggesting that more complex cases take longer time to be settled.

Based on the previous research, we consider that firm financial health measured by its level of profitability, operating performance and debt significantly determines the outcome of the procedure, as well as the time spent in the process. Firm performance proxied by its economic profitability and operating performance is expected to positively influence the bankruptcy outcome, so that economically viable firms are expected to stay longer in reorganization and have higher chances to reorganize successfully. Besides, the overall level of debt is expected to negatively influence the probability of liquidation. As suggested by

[1] In the new version of the Z" score, four variables instead of five are included, and coefficients are re-estimated.
[2] The authors specify that leverage is unrelated to post-bankruptcy profitability.

Lemmon et al. (2009), more indebted firms are more likely to be financially distressed rather than economically distressed. Consistently with the pecking order theory developed by Myers (1984), a higher level of leverage ex ante is associated with lower expected costs of financial distress. Given this, we expect that firms highly leveraged have lower chances to reorganize and therefore spend less time in reorganization before liquidation. For more robustness, we differentiate between commercial and financial debt, implying that the higher levels of commercial debt is more likely to reflect economic distress, more difficult to remedy than a short-term liquidity problem reflected by higher levels of financial debt.

Following Kim and Kim (1999), we further investigate the impact of liquidity level on the outcome of reorganization, under the assumption that the level of current assets is negatively related to the probability of reorganization. Indeed, creditors of a bankrupt firm might be more incited to cooperate and allow the latter to continue, if the level of tangible assets hardly convertible into cash is higher.

**Proposition 1. Firm financial health can be used as a proxy for post-bankruptcy prospects.**

**Proposition 1.a. Higher levels of profitability and operating performance prior to filing are positively associated with greater probabilities of continuation after bankruptcy.**

**Proposition 1.b. Time spent in reorganization before liquidation is negatively related to performance and operating margins.**

**Proposition 1.c. Overall level of debt decreases the probability of fast liquidations of reorganizing firms.**

**Proposition 1.d. The level of commercial debt is more likely to increase the probability of liquidation than financial debt.**

**Proposition 1.e. Higher liquidity levels are positively related to the probability of fast liquidation.**

### 1.3. Restructuring strategies and governance factors

Many studies underline the relevance of corporate refocusing and restructuring strategies for improving firm's post-bankruptcy performance. In this line, Dawley et al. (2002) bring up that firms refocusing their activities after bankruptcy can significantly improve their performance as measured by the three to five years of industry adjusted return

on assets. Using a sample of 135 firms which filed for Chapter 11 between 1980 and 1989, Datta and Iskandar-Datta (1995) examine various forms of restructuring which include financial, operational asset, governance and labor restructurings. They find that asset and governance restructuring are particularly beneficial for improving the performance of reorganized firms. Following Datta and Iskandar-Datta (1995), a handful of authors underlined the influence of governance restructuring on post-reorganization performance of bankrupt firms. In this field, the role of management changes during the reorganization process has been repeatedly acknowledged. Bogan and Sandler (2012) examine factors which contribute most to post-bankruptcy survival and find that new management is positively related to post-bankruptcy survival. Using a sample of 131 publicly traded companies reorganizing under Chapter 11, the authors stress that "bankruptcy can be a viable tool for reorganization, if appropriately implemented" (Bogan and Sandler, 2012: 610). Hotchkiss (1995) previously reached the same results, implying that management's role in Chapter 11 is an important source of bias towards the continuation of non-viable firms. Hotchkiss (1995) explains that poor performance associated with the continued involvement of original management is likely to be induced by two alternative mechanisms. First, new management has little incentives to lead firms with poor recovery prospects. Second, Chapter 11 bias towards the continuation of management is likely to encourage the sub-optimal behavior of existing management.

Among previous studies which relate firm governance patterns to post-reorganization survival, to our knowledge, only one paper focused on the influence of firm ownership using information on business group affiliation. In this regard, Dewaelheyns and Van Hulle (2009) explored the determinants of the time spent in reorganization by all Belgian limited liability stock corporations that filed for reorganization between 1998 and 2003, focusing on firm affiliation to a business group as well as the overall financial health of business groups, filing-firms belong to. Overall, their findings support that subsidiaries of healthy business groups are eliminated faster from the procedure, suggesting that business groups tend to benefit from their networks to terminate quickly the problems of their weak affiliates.

Literature focusing on the influence of group affiliation on bankruptcy risk is not huge. The main insight gained from previous empirical studies is consistent with an inverse relationship between firm affiliation to a business group and bankruptcy risk (Becchetti and Sierra, 2003; Dewaelheyns and Van Hulle, 2006), although much ambiguity exists with respect to the influence of group affiliation on firm performance (Bamiatzi et al., 2014). Liquidity smoothing practices are shown to be widely used by business groups to support

their affiliates, especially when the latter undergo financial difficulties (Gopalan et al., 2007). Intragroup financial transfers are argued to be driven by strategic, taxation (Dewaelheyns and Van Hulle, 2006), or other group-specific motivations (Khanna and Yafeh, 2005). Gopalan et al. (2007) argue that the bankruptcy of group affiliated firms is likely to induce negative consequences to the group as whole, namely group image and reputation. Using data from Japanese business groups, they show that the bankruptcy of one group affiliated company generates a drop in the overall level of investments, profits and external financing of the other group members.

Given the challenges associated with firm bankruptcy within a business group, we expect that group affiliation might reduce the risk of reorganization failure for affiliated firms. This is particularly plausible since business groups are deemed to make efforts trying to limit the damage to their reputation by bringing support to their weak affiliates. Besides, banks may have stronger incentives to cooperate with a business group member, rather than a stand-alone firm, especially if they consider a long-term relationship with the group as a whole (Dewaelheyns and Van Hulle, 2009). Nonetheless, we believe that the relationship between group affiliation and the outcome of bankruptcy reorganization might not be straightforward. In other words, we imply that the influence of group affiliation on the outcome of reorganization procedures might be moderated by business groups' characteristics.

Numerous researchers argue that multinational companies are inherently 'footloose' given their ability to shift their production facilities from one country to another if the present environment changes to their disadvantage (Görg and Strobl, 2003; Caves, 1996). Using Japanese data related to business groups, Inui et al. (2009) stress that multinationals tend to close their weaker affiliates. If foreign business groups are actually less incited to bring support to their struggling affiliates, than this would lead to a negative link between group affiliation to a foreign group and the time spent in reorganization.

Furthermore, group affiliation is often argued to give rise to moral hazard problems leading controlling shareholders to adopt opportunistic behavior. Corporate law considers each group component as a separate legal entity; therefore, the limited liability within business group members explains why controlling shareholders might be incited to terminate the activity of an affiliated firm in order to relieve its debt burden (Bianco and Nicodano, 2006). In accordance with the principle of separate legal entity and limited liability each bankrupt company within a business group is treated as a separate entity solely liable for its own debts with its own asset, under French bankruptcy law. Such feature has been shown to particularly encourage opportunistic behavior of parent companies within business groups in

France, leading their affiliates to go bankrupt with huge amounts of unpaid social or environmental debts[3]. Having said that, we think that there are good reasons to expect that such behavior might be exacerbated if the reorganized firm is controlled ultimately by its parent company. Literature related to internal capital markets often raise concerns for the disruptive role of business groups on firm performance and survival. In this respect, business groups are often viewed as vehicles for minority shareholders expropriation by the controlling shareholder (Khanna and Yafeh, 2007). Therefore, we imply here that moral hazard problems are more likely to be significant if the firm is majorly controlled by a main corporate owner. To sum up, this would lead to a negative link between the control of the parent company and the time spent in reorganization and a positive link with the probability of liquidation.

**Proposition 2. Business group affiliation influences both the probability of liquidation and the time spent under reorganization for group affiliated companies.**

**Proposition 2.a. Group affiliated firms have lower probabilities of liquidation than stand-alone firms, therefore might spend longer time in the reorganization procedure.**

**Proposition 2.b. The control of the parent company over the sample-affiliated firms reduces both the probability of liquidation and the length of the procedure.**

**Proposition 2.c. The pre-bankruptcy level of intragroup financial debt held by affiliated firms reduces the probability of fast liquidation for affiliated firms.**

**Proposition 2.d. Domestic business group affiliation reduces the hazard of liquidation for affiliated firms.**

## 2. Empirical approach

### 2.1. Data and the survival bias

The sampling procedure follows a two-step approach in which we (1) create a unique sample of firms that filed for a reorganization procedure from 2006 to 2007 and from 2009 to

[3] Numerous cases attest the efforts of corporate groups to voluntarily organize their insolvency as well as the difficulties for judges to detect and prove these set-ups. The Metaleurop case is very illustrative in this regard. Metaleurop Company was voluntarily put into liquidation by its parent company in order to get rid of huge environmental liabilities left unpaid after the liquidation of the company. Liquidators in charge of this case managed to obtain the extension of the responsibility to the parent company, due to the confusion between the affiliate and parent company wealth revealed.

2012[4] and (2) track each firm's path in the reorganization process, from the moment reorganization is opened to its resolution (if the procedure ended by a liquidation procedure within the time interval studied). Data gathered originate from BODACC[5] database which provides an extensive amount of information related to collective proceedings initiated inside French courts. Due to data availability, we had and information gap in the year 2008. In other words, information about what occurred in 2008, for all reorganizations opened in 2006 and 2007 is not available. In order to overcome the inherent limitations this gap could generate to our empirical analysis, information was collected manually. For each reorganization procedure initiated between 2006 and 2007, we manually collect information about liquidation decisions (if theses really occurred) within the reorganization process from two publicly available sources: "Societe.com" and "Verif.com"[6].

**Table 1 Sample structure**

| Sample year | Reorganization openings | | Exits due to liquidation | | Censored data | | Plan confirmations | |
|---|---|---|---|---|---|---|---|---|
| | N. | % | N. | % | N. | % | N. | % |
| 2006 | 963 | 9.24 | 680 | 70.61 | 283 | 29.39 | 34 | 3.53 |
| 2007 | 1,001 | 9.60 | 815 | 81.42 | 186 | 18.58 | 12 | 1.20 |
| 2009 | 154 | 1.48 | 111 | 72.07 | 43 | 27.93 | 55 | 35.71 |
| 2010 | 2,982 | 28.61 | 1,991 | 66.76 | 991 | 33.24 | 1,188 | 39.84 |
| 2011 | 2,824 | 27.09 | 1,643 | 58.18 | 1,181 | 41.82 | 893 | 31.62 |
| 2012 | 2,499 | 23.98 | 695 | 27.81 | 1,804 | 72.19 | 23 | 0.9 |
| Total | 10,423 | 100 | 5,935 | 56.94 | 4,488 | 43.06 | 2,205 | 21.15 |

Note: Table 1 depicts the time series distribution of sample firms entry and exit from reorganization. A firm is considered as exiting the reorganization procedure, if a liquidation decision is ordered by the court.

Following common practice, we complete data with information on financial accounts and ownership from firms' financial statement relative to the last fiscal year before the cessation of payments[7]. Data is obtained from Diane database, provided by Bureau Van dijk, which gathers annual financial and accounting information for French firms[8]. After excluding firms with incomplete information as well as firms from the financial service industries[9], the

[4] Data for the year 2008 is not included due to data availability.

[5] BODACC is the *Bulletin Officiel des Annonces Civiles et Commerciales*. It provides an inventory of all agreements published in the French Trade and Companies Register. Agreements gathered range from registrations to insolvency proceedings. Data gathered relates to bankruptcy proceedings and encompasses a wide range of practical details regarding all procedures initiated in the French courts. It contains information such as the date of the Cessation of Payments (in French, "Date de Cessation des Paiements"), the type of procedure initiated (Reorganization/ Liquidation), the court of the competent jurisdiction and the text form of the legal announcement.

[6] Both sources are available online and provide a wide range of legal and financial information on firms operating in France.

[7] In France, only firms that are classified bankrupt upon cessation of payments can benefit from a collective procedure of reorganization.

[8] Around 1.3 million companies established in France are annually covered by Diane source.

[9] Firms from financial services sector are not included in the analysis because they depend on a specific bankruptcy code.

sampling procedure provides a sample of 10,423 firms under reorganization. Table 1 depicts the year distribution of reorganization openings and liquidation decisions relative to our sample-firms. The bulk of the sample reorganizations are centered on the years 2010 to 2012, which coincides with the aftermath of the economic recession of 2009. Over the 10,423 reorganization openings, we observe a total of 5,935 liquidations. The total number of censored observations, i.e. time-series of firm data that do not end with an explicit failure event, is 4,488 which is equivalent to 43% of the sample. Table 1 also provides information on reorganization cases leading to the adoption of a reorganization plan. Plan confirmations are 2,205, which represents almost 21% of reorganization procedures openings.

### 2.2. Survival time

Computing survival rates is a challenging task as underlined by Couwenberg (2001) and this is all the more difficult since the level of this indicator strongly depends on the moment it is computed (LoPucki and Doherty, 2015). The problem faced when computing survival rates can be dealt with using the Kaplan-Meyer estimator, also known as the product limit estimator, a non-parametric statistic used to estimate the survival function from lifetime data. The Kaplan-Meyer estimate takes into account some types of censored data, particularly right-censored data.

Kaplan and Meier (1958) product-limit estimates of the survivor functions are graphed in Figure 1. They are given by:

$$S(t) = \prod_{j|t_j \leq t} \left( \frac{n_j - d_j}{n_j} \right)$$

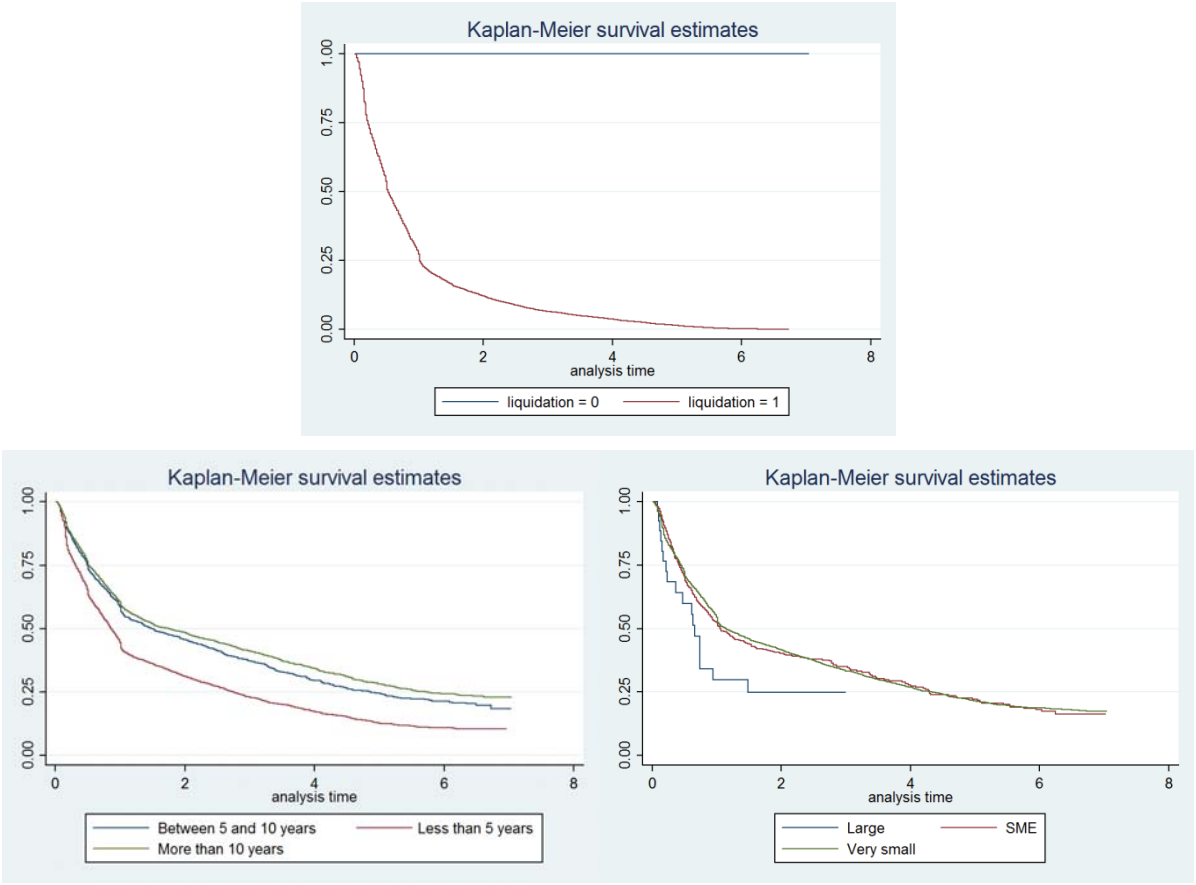
where $n_t$ is the population alive and $d_t$ is the number of failures respectively at time $t$.

Applied to our population, the computation of the Kaplan-Meier estimator provides the following results (Figure 1). The top graph of Figure 1 presents survivor functions for sample-reorganizing firms. The censored observations are plotted along the upper horizontal line. The survivor curve for liquidated firms suggests that the one-year survival rate for liquidated firms is only 25%. The lower graphs of Figure 1 depict the survivor curves of firms broken down by categorical variables of age and size[10]. At any point of time, the curve depicting the survival of older firms is strictly above that of younger firms. By contrast, the

[10] The size categories are defined based on the French classification of firms. Very small firms are defined as firms with a total amount of assets lower or equal to 2 million euro. SME are firms with a total amount of assets not exceeding 43 million euro, and finally, large firms have a total amount of assets which exceeds 43 million euro.

survivor curves for firm size suggest that larger firms drop out strictly earlier than their smaller counterparts. It is worth noticing that the survivor curves for firms partitioned by age category do not intersect, contrarily to firm size. This can be interpreted as a first indication that some variables do not satisfy the proportionality assumption underlying the Cox proportional hazards model applied in this paper.

**Figure 1 Kaplan-Meier survivor estimates**




Note: Figure 1 is based on a sample of 10,423 French reorganized firms between 2006 and 2012. The nonparametric estimate of the survivor function is the Kaplan and Meier (1958) estimate.

## 2.3. Two-stage analysis of firm survival

In view to explore several aspects related to the survival of French firms under reorganization, we conduct a two-stage analysis: the first one aims to assess the variables which discriminate the best between surviving and liquidated firms and the second one aims to explore the determinants of the instantaneous risk of liquidation for reorganizing firms.

The first stage of investigation is achieved using a Random Forest model. Introduced by Breiman in 2001, Random Forests algorithm is a classifier consisting of a collection of

decision trees[11] drawn from bootstrap samples built from the studied sample. At each node of the tree, Random Forests select a random subset of variables which are used as candidates to find the best split for the node. The purpose of this two-step randomization is the decorrelation of the trees, so that the variance of the forest ensemble is reduced (Chen & Ishwaran, 2012). After a large number of trees are generated, they vote for the most popular class of variables (Figure 3-3). We do not limit ourselves to use simple regression trees because, despite being a very compelling method, they suffer from a major problem of instability[12] (Breiman, 1996).

The construction of a Random Forests algorithm can be summarized by the following steps: i) *n* tree bootstrap samples are first drawn from the original data, ii) a tree for each bootstrap data is then grown by randomly selecting variables for splitting each node into two child nodes, iii) information is finally aggregated from the *n* trees. An interesting feature of Random Forests is the measure of variable importance that can be used to rank variables according to their explanatory power (Chen and Ishwaran, 2012). Variable importance is estimated by looking at the change in the error prediction rate when data for each variable is permuted while all others are left unchanged (Liaw and Wiener, 2002).

The second stage of investigation proceeds with a survival analysis. Survival time is measured as a nonnegative random time-variable T which measures the time elapsed between the opening of the reorganization procedure and the decision of liquidation. The main advantage from survival analysis is the use of censored data (i.e. firms for which information on what happened after entering the reorganization process is missing). The instantaneous rate of failure at time $t$ given that the firm survives until $t$ is given by the hazard function $\lambda(t)$ which is defined as the limit:

$$\lambda(t) = \lim_{\Delta \to 0} \frac{P(t \leq T + \Delta t | T \geq t)}{\Delta t}$$

The numerator is the conditional probability that failure will occur in the interval $[t, t + dt)$ given that the firm has survived until $t$, and the denominator is the width of the interval. We use the Cox (1972) proportional hazard model which is the reference model for multivariate survival analysis. In a Cox model, firm hazard of failure $\lambda(t|x_j)$ is computed as a multiplicative function of a common baseline hazard $\lambda_0(t)$ and a firm-specific vector of covariates $X = (x_1, \dots, x_j)$. The firm hazard of failure can be written as follows:

[11] Random Forests is often a collection of hundreds to thousands of trees, where each tree is grown using a bootstrap sample of the original data (Chen & Ishwaran, 2012).

[12] An algorithm is said "unstable" if the latter fails to make a clear distinction between persistent and random patterns in the data, a phenomenon known as *overfitting*

$$\lambda(t|x_j) = \lambda_0(t)\exp(x_1\beta_1 + \cdots + x_j\beta_j) = \lambda_0(t)\exp(x_j\beta)$$

The Cox model is semi-parametric, since it considers the risk of failure of a given firm as depending on a baseline hazard which remains unspecified, and a risk which depends on firm's characteristics measured by the vector of explanatory variables. The main assumption of this model is the proportionality hypothesis which requires that hazard ratios are constant over time, or equivalently that the relative hazard rate of two different firms is solely explained by the parametric part of the model (i.e. firm characteristics). This results in the following relationship between the hazard ratios of two different individuals:

$$HR = \frac{\hat{h}(t, X^*)}{\hat{h}(t, X)} = \frac{h_0(t)\exp(\sum_{j=1}^{p}\beta_j X_j^*)}{h_0(t)\exp(\sum_{j=1}^{p}\beta_j X_j)} = \exp(\sum_{j=1}^{p}\hat{\beta}_j (X_j^* - X_j))$$

Several methods exist to test for this assumption. In this paper, we have analyzed the Schoenfeld residuals[13], but do not report results for sake of brevity. In most tested models, size, sector and region are shown to deviate from this assumption. To resolve this issue, all models are stratified with these variables as stratas[14]. The stratification process allows variables to be adjusted for without estimating their effect. It also allows the form of the underlying hazard function to vary across levels of stratification variables.

Let $Z_1, \ldots Z_k$ denote the variables not satisfying the proportional hazard assumption, and $Z^*$ the categorical variable of all possible combinations between the $Z_k$ variables. Stratas are then the categories of $Z^*$. The general stratified Cox model is given by:

$$\lambda_g(t|X) = \lambda_{0g}\exp(\beta_1 x_1 + \cdots + \beta_p x_p)$$

with $g = 1, \ldots, k^*$ strata defined from $Z^*$, and $X_1, \ldots X_p$ the variables satisfying the proportional hazards assumption.

## 3. Results and discussions

### 3.1. Random forests

The first stage of our empirical analysis is a Random Forests model applied to the entire sample of 10,423 firms which entered a reorganization procedure between 2006 and 2012. Kaplan-Meier survival estimates displayed in Figure 2 show that sample-firms' survival rate drop out to 50% by the first year after reorganization opening. Therefore, we first build a

[13]Schoenfeld residuals after a Cox model are defined for each predictor variable in the model. The null hypothesis for the test on proportional hazards base on the scaled Schoenfeld residuals is that the slope of Schoenfeld residuals against a function of time is zero for each predictor variable. A non-zero slope is thus an indication of a violation of the proportional hazard assumption. To compute theses residuals, we used the 'estat phtest, detail' Stata command, for each model specification.

[14] Stata 12.1 software allows up to five strata variables

forest of 100 trees in view to identify the determinants of firm liquidation within the first year of reorganization. The response variable equals 1 if the firm is liquidated before the end of the year after the opening of the reorganization procedure and 0 otherwise. The explanatory variables include firm structural characteristics and a wide range of financial and economic health indicators. Figure 2 displays the results relative to the Random Forest at the one year-time horizon. The left graph plots the variable importance measure produced. The measure of variable importance provided by the Random Forests algorithm can be used to rank variables (Chen & Ishwaran, 2012). It is estimated by looking at the change in the error prediction rate when data for each variable is permuted while all others are left unchanged (Liaw and Wiener, 2002).

The graph also shows that firm affiliation to business group is classified at the lowest rank, suggesting that group membership has practically no influence on the probability of liquidation within one year. The major shortcoming of Random Forests is that variable ranking does provide information only on the intensity of the influence of each variable, without any information on the way the explanatory variable influences the response variable. Nonetheless, the results provided by Random Forests model remain very useful. Indeed, contrarily to classical parametric models, Random Forests is not based on binding assumptions regarding the distribution of the data. It particularly allows including an infinite number of variables without any concern for the potential multicollinearity problem between variables. This enables us to explore all possible variables with have a significant explanatory power of the probability of liquidation within the reorganization process. The overall accuracy of our model is presented in the right graph which plots the sensitivity (true positive rate) in function of the specificity of the model (the false positive rate). The graph shows that the forest has a GINI index estimated around 79% equivalent to an AUC[15] of 89.25%, which suggest that the model is quite adequate.

The left graph of Figure 2 shows that among all variables included in the dataset, firm age has the greatest influence on the outcome variable of liquidation within the first year of reorganization. By order of importance, firm size (measured as the total amount of assets), operating margins, liquidity level (measured by the quick ratio), sector affiliation as well as the macroeconomic conditions (proxied by the variable *Before 2009*) have the greatest

[15] Area under the ROC-curve (AUC) is a measure of performance for prediction accuracy. The higher the value of AUC, the better the model is. Gini calculation is closely related to the calculation of AUC. It can be computed by GINI=2*AUC-1.

explanatory power of firm probability of liquidation within the first of reorganization. Firm profits and leverage are also shown to influence the risk of liquidation at the one-year horizon.

**Figure 2 Variable importance plot: one-year horizon (100 trees)**

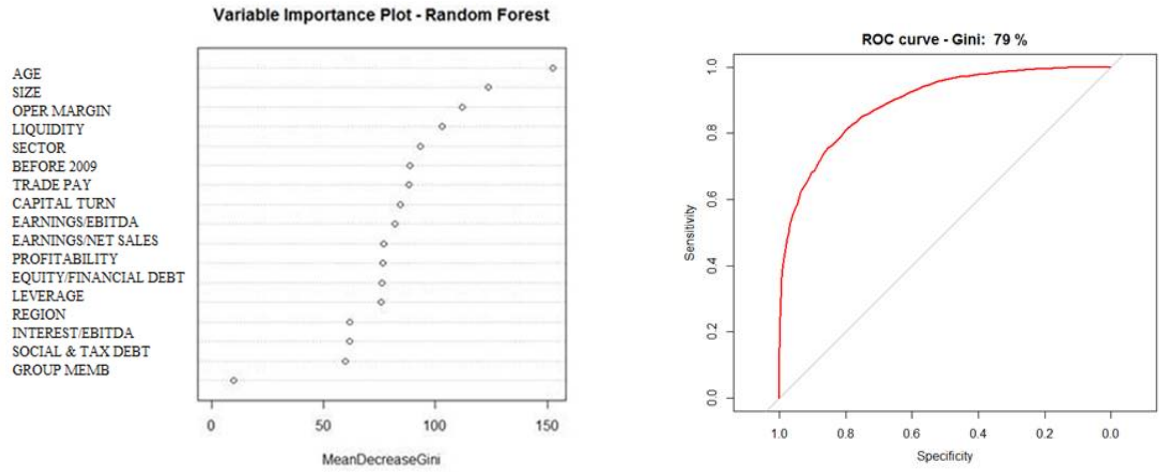
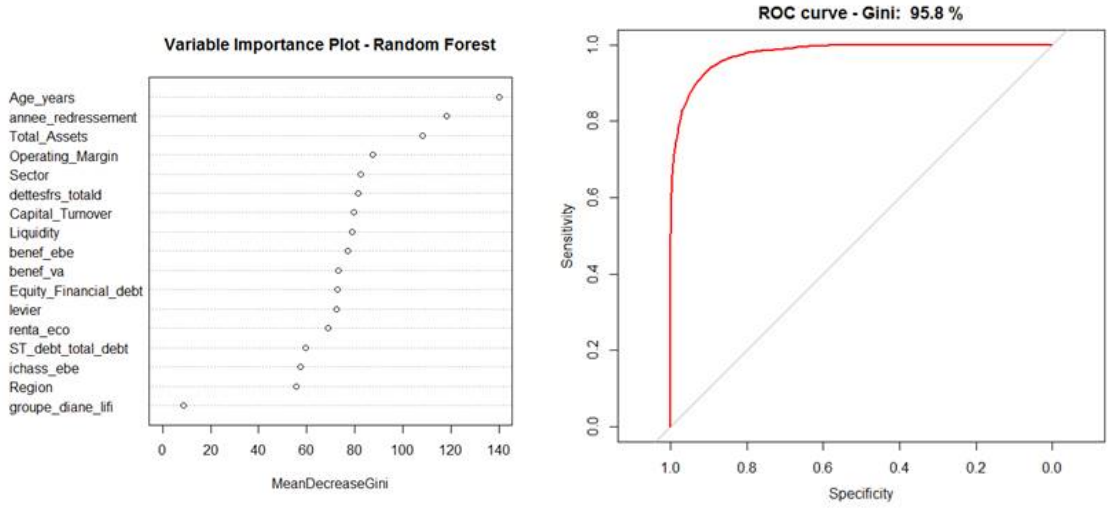



**Figure 3 Variable importance plot: two-years horizon (100 trees)**




We again apply the same algorithm over the entire sample of reorganizing firms. The outcome variable is now binary, accounting for firm's status (liquidated/still operating) by the second year after reorganization opening. The results are presented in Figure 3. Globally, variable ranking remains almost the same with firm age as the most influent variable on the probability of liquidation within two years from reorganization opening. The only significant difference with the first model is the variable *Before 2009* accounting for the macroeconomic conditions and which is particularly powerful to explain firm survival (or equivalently, liquidation) until the year-2 after bankruptcy. The overall accuracy of the model is shown in the right graph figure 3. The GINI index of 95.8, equivalent to an AUC of 97.9% suggests that firm characteristics (age, size and sector) and financial health measures, as well as the

macroeconomic conditions are very significant determinants of firm survival in the first two years of the reorganization process.

### 3.2. Survival analysis

In view to bring more insights into firm survival after bankruptcy, we focus in the following on the determinants of the time-span elapsed until liquidation. Therefore, the second stage of analysis proceeds with a survival analysis performed using the Cox Proportional Hazards model. Survival time for firms liquidated within the studied period (i.e. until December 2012) is computed as the time elapsed between the liquidation decision and the reorganization opening. For firms with censored data, i.e. firms for which information on liquidation is not available, the survival time is the time elapsed between the reorganization opening and the end of the studied period (i.e. end of the year 2012). Table 2 below provides detailed results of different specifications of the Cox model applied to the entire sample of firms filing for reorganization. All estimations are stratified with sector, region and size as stratas.

The estimated hazard ratios displayed in Table 2 indicate that firm age decreases the hazard of liquidation. Indeed, the hazard ratio of the variable AGE equals 0.765 and is significant at 1%. This means that an increase of firm age by one year reduces the hazard of liquidation by 23.5%. This result is not surprising since older firms are deemed to have better abilities to resist to shocks hitting directly or indirectly their activities (Stinchcombe, 1965; Thornhill and Amit, 2003). Similarly, the variable *Before 2009* accounting for the stage of the economy suggests that firms entering a bankruptcy procedure before the economic downturn of 2009 are able to survive longer in the reorganization procedure. This could either mean that the crisis of 2009 had severe consequences on French firms, making their recovery process more difficult, or that the creditors where less incited to cooperate with reorganizing firms in unfavorable economic climate. The effect of debt leverage is as predicted. Higher levels of debt relative to total assets are likely to increase the hazard of liquidation for reorganizing firms.

Nonetheless, it is worth noting that the hazard ratio is not significantly different from 1, suggesting that the effect of firm leverage might be marginal. In contrast, the hazard of liquidation is likely to be lower for a relatively higher level of financial debt. Our suggestion is that firms with more financial debt are more likely to be viable. Indeed, financial institutions are more likely to provide funding for firms they believe have sufficient capacity to repay their debt later. Turning to the impact of firm economic performance as measured by

the ratio of operating margins and the ratio of profitability, we find that firms with better economic performance survive longer after bankruptcy. Finally the hazard ratio of group affiliation to a business groups is not significant implying that stand-alone firms and affiliated firms have equal hazards of liquidation. In the following we aim to explore in more depth whether business group affiliation benefits equally to all group affiliated firms. For this aim, we only focus on group affiliated firms and evaluate whether group characteristics have any influence on firms' hazard of liquidation.

**Table 2 Survival analysis: total sample**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio |
| AGE | 0.765*** | 0.765*** | 0.759*** | 0.764*** | 0.761*** | 0.760*** | 0.787*** |
| | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.014) |
| BEFORE 2009 | 0.654*** | 0.654*** | 0.648*** | 0.655*** | 0.650*** | 0.649*** | 0.603*** |
| | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.025) |
| LIQUIDITY | | 1.000 | | | | | |
| | | (0.001) | | | | | |
| LEVERAGE | | 1.007*** | 1.007*** | | 1.006*** | 1.006*** | 1.006*** |
| | | (0.001) | (0.001) | | (0.001) | (0.001) | (0.001) |
| ASSETS SPEC | | | | 0.871 | | | |
| | | | | (0.074) | | | |
| OPER MARGIN | | | | 0.883*** | 0.896*** | | 0.902*** |
| | | | | (0.018) | (0.018) | | (0.021) |
| TRADE PAY | | | 1.353*** | | 1.352*** | 1.352*** | 1.371*** |
| | | | (0.096) | | (0.096) | (0.096) | (0.108) |
| FINANC DEBT | | | 0.772*** | | 0.780*** | 0.777*** | 0.775*** |
| | | | (0.053) | | (0.053) | (0.053) | (0.058) |
| PROFITABILITY | | | | | | 0.920*** | |
| | | | | | | (0.018) | |
| GROUP MEMB | | | | | | | 0.988 |
| | | | | | | | (0.031) |
| Log likelihood | -26879.663 | -26872.12 | -26852.003 | -26864.17 | -26840.803 | -26844.604 | -22218.1 |
| LR ($chi^2$) | 415.66*** | 426.49*** | 466.51*** | 446.64*** | 488.91*** | 481.31*** | 398.77*** |
| No. of failures | 5,935 | 5,935 | 5,935 | 5,935 | 5,935 | 5,935 | 5,036 |
| No. of observations | 10,423 | 10,423 | 10,423 | 10,423 | 10,423 | 10,423 | 9,318 |

Note: Table 2 displays the results of different Cox proportional hazards model estimating the survival of a sample of 10,423 French firms attempting reorganization between 2006 and 2012. Results displayed are the hazard ratios.

Table 3 reports the results of Cox model applied to our subsample of 3,029 affiliated firms. All estimations are stratified by sector and region as stratas. The estimated effects of firm age, leverage and economic profitability on the hazard of liquidation are the same as previous. Interestingly, firm size and affiliation to a domestic business group are shown to increase the hazard of liquidation for group affiliated firms. This means that larger firms and those affiliated to French business groups are liquidated faster than smaller ones. Still, the

estimated effect of affiliation to a French group on the hazard of liquidation is stronger than that of firm size. These results indicate that either French judges are biased towards the rescue of domestic groups, or that domestic groups are less involved in the rescue of their struggling affiliates. In contrast, the hazard of liquidation is likely to be reduced by the control of the parent company. Contrarily to what expected, the estimated hazard ratio of *MAJOR CONTROL* variable suggests that the hazard of liquidation for firms majorly controlled by their parent company is 20% lower everything else constant. This positive relationship between the percentage of control of the parent company and firm survival provides evidence that parent companies might be more involved in the rescue of their controlled affiliates. Firm liquidity is found to increase the hazard of liquidation, suggesting that firms with lower levels of liquidity are less likely to be liquidated in a short period of time after the filing.

**Table 3 Survival analysis: group affiliated firms**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio |
| AGE | 0.832*** | 0.827*** | 0.824*** | 0.819*** | 0.820*** | 0.824*** | 0.824*** | 0.820*** |
| | (0.027) | (0.027) | (0.027) | (0.027) | (0.027) | (0.027) | (0.027) | (0.026) |
| SIZE | 1.050** | 1.050** | 1.049** | 1.058*** | 1.039*** | 1.050*** | 1.061*** | 1.028 |
| | (0.021) | (0.021) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) |
| BEFORE 2009 | 0.495*** | 0.488*** | 0.487*** | 0.491*** | 0.506*** | 0.487*** | 0.494*** | 0.502*** |
| | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.041) |
| LIQUIDITY | | 1.208*** | 1.187*** | 1.205*** | 1.219*** | 1.223*** | 1.225*** | 1.216*** |
| | | (0.037) | (0.039) | (0.038) | (0.039) | (0.039) | (0.039) | (0.037) |
| LEVERAGE | | 1.027** | 1.028** | 1.036*** | 1.031** | 1.034** | 1.026 | |
| | | (0.011) | (0.011) | (0.013) | (0.013) | (0.013) | (0.013) | |
| ASSETS SPEC | | | | 0.858 | | | | |
| | | | | (0.178) | | | | |
| OPER MARGIN | | | | 0.766*** | 0.765*** | 0.759*** | 0.753*** | 0.776*** |
| | | | | (0.059) | (0.058) | (0.058) | (0.058) | (0.061) |
| TRADE PAY | | | 1.309* | 1.258 | | | | |
| | | | (0.186) | (0.179) | | | | |
| FINANC DEBT | | | 0.771* | 0.793 | | | | |
| | | | (0.114) | (0.118) | | | | |
| DOMESTIC GR | | | | | 1.198*** | | | 1.183** |
| | | | | | (0.08) | | | (0.08) |
| MAJOR CONTROL | | | | | | 0.806*** | | 0.819** |
| | | | | | | (0.065) | | (0.066) |
| GROUP DEBT | | | | | | | 1.107 | 1.202 |
| | | | | | | | (0.137) | (0.137) |
| Log likelihood | -6314.1008 | -6302.4903 | -6297.8138 | -6291.9877 | -6292.5111 | -6292.6376 | -6291.7689 | -6286.1417 |
| LR ($chi^2$) | 131.25*** | 154.47*** | 163.82*** | 175.47*** | 174.43*** | 174.17*** | 166.61*** | 177.87*** |
| No. of failures | 1,672 | 1,672 | 1,672 | 1,672 | 1,672 | 1,672 | 1,672 | 1,672 |
| No. of observations | 3,029 | 3,029 | 3,029 | 3,029 | 3,029 | 3,029 | 3,029 | 3,029 |

Note: Table 3 displays the results of different Cox proportional hazards model estimating the survival of a sample of 3,029 French affiliated firms attempting reorganization between 2006 and 2012. Results displayed are the hazard ratios.

The opening decision of a Judicial Reorganization procedure leads to an observation period of 6 months renewable twice exceptionally. During the observation period, a court appointed administrator evaluates firm's recovery prospects and decides whether

business should be continued under a reorganization plan or sold as going concern to a third party or liquidated. Given this, we pursue our analysis of firm survival within reorganizations, focusing on two distinct elements: the observation period and the reorganization plan. The first set of estimations are presented in the columns 1 to 3 of Table 4 and aim to explore firm survival during the observation period for all sample-firms, more particularly, the first 6 months. All estimations are stratified by sector, region and size. The second set of estimations are reported in the last three columns of Table 4 and aim to explore the survival after plan adoption of 2,205 sample firms with available information on reorganization plan adoption. All estimations are stratified by sector and region.

**Table 4 Survival analysis during observation period and after plan confirmation for the entire sample**

| | **Survival up to 6 months** | | | **Survival after plan confirmation** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio |
| AGE | 0.754*** | 0.759*** | 0.764*** | 0.782*** | 0.760*** | 0.805*** |
| | (0.017) | (0.017) | (0.022) | (0.058) | (0.057) | (0.064) |
| SIZE | | | | 0.874** | 0.880** | 0.883** |
| | | | | (0.050) | (0.049) | (0.048) |
| BEFORE 2009 | 0.765*** | 0.763*** | 0.751*** | 0.901*** | 0.899 | 0.875 |
| | (0.041) | (0.040) | (0.049) | (0.288) | (0.289) | (0.311) |
| LIQUIDITY | 1.000 | | | 0.854 | | |
| | (0.001) | | | (0.153) | | |
| LEVERAGE | 1.007*** | 1.007*** | 1.007*** | 0.879 | | |
| | (0.001) | (0.001) | (0.001) | (0.073) | | |
| ASSETS SPEC | | 1.101 | | | 0.551 | |
| | | (0.138) | | | (0.217) | |
| OPER MARGIN | | 0.885*** | 0.890*** | | 1.019 | |
| | | (0.021) | (0.023) | | (0.120) | |
| TRADE PAY | 1.263** | 1.263** | 1.272** | 2.197** | 2.181** | 2.767*** |
| | (0.128) | (0.128) | (0.143) | (0.712) | (0.682) | (0.919) |
| FINANC DEBT | 0.627*** | 0.636*** | 0.644*** | 0.790 | | |
| | (0.064) | (0.065) | (0.073) | (0.248) | | |
| GROUP MEMB | | | 1.004 | | | 0.889 |
| | | | (0.047) | | | (0.121) |
| SECTOR dummies | - | - | - | NO | NO | NO |
| REGION dummies | - | - | - | NO | NO | NO |
| Log likelihood | -13941.169 | -13931.375 | -11382.705 | -2120.4663 | -2121.1746 | -1923.2886 |
| LR ($chi^2$) | 208.37*** | 227.95*** | 178.67*** | 71.76*** | 70.35*** | 62.38*** |
| No. of failures | 2,734 | 2,734 | 2290 | 305 | 305 | 305 |
| No. of observations | 10,423 | 10,423 | 9,318 | 2,205 | 2,205 | 2,205 |

Note: Table 4 displays the results of different Cox proportional hazards model estimating the survival of different cutoffs of a sample of 10,423 French firms attempting reorganization between 2006 and 2012. Columns 1 to 3 estimate the survival up to 6 months after the procedure opening. Columns 4 to 6 estimate the survival of 2,205 firms after reorganization plan confirmation. Results displayed are the hazard ratios.

Overall, estimated hazard ratios confirm that firm age reduce the hazard of liquidation at both the observation period and after plan adoption. Interestingly, firm size is shown to decrease the hazard of liquidation after adoption, suggesting that larger firms are more likely to survive after a reorganization plan is adopted. Macroeconomic conditions seem to have a significant influence only on firm survival on the short term (i.e. during the observation period). Consistently with the findings of Barniv et al. (2002), our results suggest that accounting variables used in prior literature for predicting financial distress or bankruptcy are nor more useful to the predict the final bankruptcy resolution, in particular after plan adoption. This leads us to think that firm financial characteristics are strong determinants of survival in reorganization on the short term. In contrast, the success of reorganization plans might not depend significantly on firm characteristics but on the content of the plan and the way the plan is implemented.

**Table 5 Survival analysis during observation period and after plan confirmation for group affiliates**

| | **Survival up to 6 months** | | | | **Survival after plan confirmation** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio | Haz.Ratio |
| AGE | 0.788*** | 0.797*** | 0.802*** | 0.790*** | 0.857 | | | |
| | (0.036) | (0.037) | (0.036) | (0.036) | (0.123) | | | |
| SIZE | | | | | 0.774** | 0.720*** | 0.717*** | 0.735*** |
| | | | | | (0.072) | (0.071) | (0.071) | (0.076) |
| BEFORE 2009 | 0.677*** | 0.633*** | 0.643*** | 0.658*** | 0.495 | | | |
| | (0.085) | (0.085) | (0.080) | (0.083) | (0.392) | | | |
| LIQUIDITY | 1.175*** | 1.195*** | 1.198*** | 1.195*** | 0.731 | | | |
| | (0.040) | (0.039) | (0.039) | (0.039) | (0.313) | | | |
| LEVERAGE | 1.012 | | | | 1.130 | | | |
| | (0.026) | | | | (0.276) | | | |
| OPER MARGIN | 0.738*** | 0.7195*** | 0.727*** | 0.729*** | | | | |
| | (0.083) | (0.082) | (0.082) | (0.082) | | | | |
| TRADE PAY | 1.358 | | | | 5.344*** | 5.529*** | 5.41*** | 5.87*** |
| | (0.284) | | | | (3.22) | (3.21) | (3.09) | (3.42) |
| FINANC DEBT | 0.746 | | | | 0.663 | | | |
| | (0.164) | | | | (0.439) | | | |
| DOMESTIC GR | 1.200** | | | 1.183** | 0.69 | | | 0.726 |
| | (0.111) | | | (0.111) | (0.322) | | | (0.33) |
| MAJOR CONTROL | | 0.731*** | | 0.754** | | 1.199 | | 1.177 |
| | | (0.086) | | (0.086) | | (0.53) | | (0.52) |
| GROUP DEBT | | | 1.205 | 1.161 | | | 1.848 | 1.922 |
| | | | (0.190) | (0.186) | | | (1.92) | (2.07) |
| Log likelihood | -2910.4591 | -2912.1885 | -2914.485 | -2909.7123 | -509.03134 | -510.9639 | -510.88999 | -510.5405 |
| LR ($chi^2$) | 68.13*** | 64.67*** | 58.96*** | 68.51*** | 42.71*** | 38.18*** | 38.32*** | 39.02*** |
| No. of failures | 750 | 750 | 750 | 750 | 90 | 90 | 90 | 90 |
| No. of observations | 3,029 | 3,029 | 3,029 | 3,029 | 681 | 681 | 681 | 681 |

Note: Table 5 displays the results of different Cox proportional hazards model estimating the survival of different cutoffs of a sample of 3,029 French affiliated firms attempting reorganization between 2006 and 2012. Columns 1 to 3 estimate the survival up to 6 months after the procedure opening. Columns 4 to 6 estimate the survival of 681 affiliated firms after reorganization plan confirmation. Results displayed are the hazard ratios.

The same estimations are applied for only group affiliated firms in both cases: survival during the observation period and survival after plan confirmation. Results are displayed in

Table 5. Findings confirm the previous conclusions and further suggest that group characteristics are more significant to explain firm survival at the short term.

## Conclusion

Because of the controversial nature of bankruptcy reorganization procedure, it has been subject to active research. In this regard, the US Chapter 11 reorganization procedure was a matter of particular concern. In attempt to investigate the practical worth of the bankruptcy reorganization process, a great deal of research has been concerned by the 'success' of the procedure from different perspectives. Initial studies of the outcomes of bankruptcy were focused on the examination of the number of firms emerging from the process. Later the research was extended to finding the determinants of both the 'success' of the procedure as well as the performance of firms emerging from the process. The divergent results related to the various measures of 'success' and performance of emerging firms does not allow however to draw generalizable conclusions regarding the effectiveness of the process.

This paper investigated the determinants of firm survival after reorganization, taking into account the time spent under reorganization which is still scarcely explored in previous research. The originality of our work is attributable to the unique dataset which is drawn from a largely unexplored population, a sample of mostly small and medium sized firms. Our analysis is also original since it is among the very few studies to bring insights into European reorganization procedures and particularly France.

When predicting the final outcome of bankruptcy, the power of financial indicators might not be as effective, since most bankrupt firms might share similar characteristics. Therefore, the importance of the use of non-financial variables to complete the analysis becomes very high (Laitinen, 2011). In this regard, we use new variables, partly used previously by Dewaelheyns and Van Hulle (2009). It is firm affiliation to a business group and business groups characteristics. The expected relationship between firm affiliation to a business group and the outcome of bankruptcy is mainly driven from the previous literature on business groups' internal capital markets and their impact on firm performance.

Using two empirical models, barely associated into one study, the semi-parametric Cox proportional Hazards model and the non-parametric Random Forests model, we reach strong evidence on the relevance of firms' financial and operational characteristics at triggering for the prediction of the outcome and duration of reorganization procedures, notably on the short term. Interestingly, our findings suggest that the power of firm financial

characteristics as well as business groups' characteristics might however not be very high for predicting the final outcome of bankruptcy in particular after reorganization plan confirmation. These results lead us to think that, more than firm and group characteristics, the robustness of the reorganization plan and its implementation might have more explanatory power for predicting the final outcome of bankruptcy. A natural extension of this research would therefore be to explore the changes in firm financial situation during the reorganization process and their influence on the outcome of the procedure.

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# Appendices

**Table 6 Sample characteristics**

| | Whole sample | | | | | Plan Confirmation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Liquidations** | **%** | **Censored** | **%** | **Total** | **Liquidations** | **%** | **Censored** | **%** | **Total** |
| **REGION** | | | | | | | | | | |
| Greater Paris Region | 820 | 61.93 | 504 | 38.07 | 1,324 | 33 | 13.20 | 217 | 86.80 | 250 |
| North East | 1,098 | 56.57 | 843 | 44.43 | 1,941 | 48 | 12.63 | 332 | 87.37 | 380 |
| South East | 1,289 | 54.97 | 1,056 | 45.03 | 2,345 | 70 | 13.23 | 459 | 86.77 | 529 |
| South West | 1,068 | 57.85 | 778 | 42.15 | 1,846 | 70 | 17.81 | 323 | 82.19 | 393 |
| Central Region | 602 | 54.23 | 508 | 45.77 | 1,110 | 34 | 12.83 | 231 | 87.17 | 265 |
| North West | 1,058 | 56.97 | 799 | 43.03 | 1,857 | 55 | 14.18 | 333 | 85.82 | 388 |
| **Total** | **5,935** | | **4,488** | | **10,423** | **310** | | **1,895** | | **2,205** |
| **SECTOR** | | | | | | | | | | |
| Food industry | 34 | 50.00 | 34 | 50.00 | 68 | 1 | 4.76 | 20 | 95.24 | 21 |
| Manufacturing industry | 902 | 52.41 | 819 | 47.59 | 1,721 | 37 | 9.59 | 349 | 90.41 | 386 |
| Construction | 1,671 | 61.34 | 1,053 | 38.66 | 2,724 | 107 | 18.90 | 459 | 81.10 | 566 |
| Retailing | 1,121 | 57.75 | 820 | 42.25 | 1,941 | 48 | 12.83 | 326 | 87.17 | 374 |
| Transport and Mail | 279 | 55.91 | 220 | 44.09 | 499 | 16 | 15.24 | 89 | 84.76 | 105 |
| Hotels and Restaurants | 635 | 54.13 | 538 | 45.87 | 1,173 | 30 | 11.54 | 230 | 88.46 | 260 |
| NTIC | 145 | 54.92 | 119 | 45.08 | 264 | 3 | 7.32 | 38 | 92.68 | 41 |
| Real Estate | 106 | 58.56 | 75 | 41.44 | 181 | 6 | 15.38 | 33 | 84.62 | 39 |
| Business services | 661 | 59.76 | 445 | 40.24 | 1,106 | 30 | 13.82 | 187 | 86.18 | 217 |
| Household services | 381 | 51.07 | 365 | 48.93 | 746 | 32 | 16.33 | 164 | 83.67 | 196 |
| **Total** | **5,935** | | **4,488** | | **10,423** | **310** | | **1,895** | | **2,205** |
| **GROUP CHARACTERISTICS** | | | | | | | | | | |
| DOMESTIC GROUP | 379 | 49.61 | 385 | 50.39 | 764 | 6 | 5.13 | 111 | 94.87 | 117 |
| FOREIGN GROUP | 1,293 | 57.09 | 972 | 42.91 | 2,265 | 84 | 14.89 | 480 | 85.11 | 564 |
| **Total** | **1,672** | | **1,357** | | **3,209** | **90** | | **591** | | **681** |
| MAJOR CONTROL | 1,472 | 54.18 | 1,245 | 45.82 | 2,717 | 84 | 13.53 | 537 | 86.47 | 621 |
| MINOR CONTROL | 200 | 64.10 | 112 | 35.90 | 312 | 6 | 10.00 | 54 | 90.00 | 60 |
| **Total** | **1,672** | | **1,357** | | **3,209** | **90** | | **591** | | **681** |

**Table 7 Variable definition**

| **Variable Name** | **Definition** |
|---|---|
| **Firm financial and economic characteristics** | |
| SIZE | Log(total assets) |
| AGE | Log(years between the date of establishment and the date of bankruptcy) |
| LIQUIDITY | Ratio: (Current Assets-Inventory and W.I.P)/ Current Liabilities |
| LEVERAGE | Ratio: Total Debt/Total Assets |
| FINANC DEBT | Ratio: Financial Debt/Total Debt |
| TRADE PAY | Ratio: Trade Debt/Total Debt |
| PROFITABILITY | Ratio: Operating Income/Total Assets |
| OPER MARGIN | Ratio: EBITDA/Net Sales |
| ASSETS SPEC | Ratio: Fixed Assets – Land and Buildings/Total Assets |
| GROUP MEMB | Dummy: value=1 if company is affiliated to a business group |
| **Group characteristics** | |
| UCO CONTROL | Dummy: value=1 if company is controlled at more than 50% by the parent company |
| Domestic GR | Dummy: value=1 if company is controlled by a domestic group |
| GROUP DEBT | Ratio: Net borrowing from the group/ Total Assets |

**Table 8 Sample descriptive statistics**

| | | Total Sample | | | Plan Confirmations | | |
|---|---|---|---|---|---|---|---|
| | | **Liquidations** | **Censored** | **Total** | **Liquidations** | **Censored** | **Total** |
| AGE | Mean | 1.89 | 2.17 | 2.01 | 1.92 | 2.14 | 2.11 |
| | Median | 1.81 | 2.16 | 1.97 | 1.84 | 2.13 | 2.10 |
| | Std | 0.91 | 0.85 | 0.90 | 0.89 | 0.83 | 0.84 |
| SIZE | Mean | 12.46 | 12.64 | 12.54 | 12.30 | 12.58 | 12.54 |
| | Median | 12.32 | 12.55 | 12.43 | 12.23 | 12.51 | 12.46 |
| | Std | 1.43 | 1.28 | 1.37 | 1.19 | 1.24 | 1.24 |
| LIQUIDITY | Mean | 0.60 | 0.75 | 0.67 | 0.48 | 0.47 | 0.47 |
| | Median | 0.45 | 0.42 | 0.44 | 0.40 | 0.39 | 0.39 |
| | Std | 3.73 | 17.28 | 11.68 | 0.36 | 0.41 | 0.40 |
| LEVERAGE | Mean | 1.38 | 1.14 | 1.27 | 1.16 | 1.17 | 1.17 |
| | Median | 0.96 | 0.96 | 0.96 | 0.97 | 0.97 | 0.97 |
| | SD | 9.11 | 0.89 | 6.90 | 0.56 | 0.96 | 0.91 |
| ASSETS SPEC | Mean | 0.14 | 0.14 | 0.14 | 0.14 | 0.15 | 0.15 |
| | Median | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| | Std | 0.17 | 0.17 | 0.17 | 0.16 | 0.18 | 0.17 |
| OPER MARGIN | Mean | -0.17 | -0.10 | -0.14 | -0.15 | -0.13 | -0.13 |
| | Median | -0.04 | -0.01 | -0.03 | -0.05 | -0.03 | -0.03 |
| | Std | 0.67 | 0.38 | 0.56 | 0.38 | 0.45 | 0.44 |
| TRADE PAY | Mean | 0.28 | 0.26 | 0.27 | 0.27 | 0.26 | 0.26 |
| | Median | 0.25 | 0.24 | 0.24 | 0.25 | 0.22 | 0.23 |
| | Std | 0.20 | 0.19 | 0.20 | 0.19 | 0.19 | 0.19 |
| FINANC DEBT | Mean | 0.16 | 0.18 | 0.17 | 0.16 | 0.18 | 0.18 |
| | Median | 0.06 | 0.10 | 0.08 | 0.05 | 0.10 | 0.09 |
| | Std | 0.20 | 0.21 | 0.21 | 0.21 | 0.22 | 0.21 |
| PROFITABILITY | Mean | -0.21 | -0.14 | -0.18 | -0.20 | -0.18 | -0.18 |
| | Median | -0.07 | -0.05 | -0.06 | -0.08 | -0.06 | -0.07 |
| | Std | 0.72 | 0.40 | 0.60 | 0.40 | 0.46 | 0.45 |

Note: This table displays descriptive statistics for the financial and economic characteristics of sample of 10,423 firms attempting reorganization between 2006 and 2012.

**Table 9 Correlation matrix**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| AGE (1) | 1 | | | | | | | | |
| SIZE (2) | 0.377*** | 1 | | | | | | | |
| | (0.000) | | | | | | | | |
| LIQUIDITY (3) | 0.00506 | -0.00638 | 1 | | | | | | |
| | (0.606) | (0.515) | | | | | | | |
| LEVERAGE (4) | -0.00571 | -0.104*** | -0.00463 | 1 | | | | | |
| | (0.560) | (0.000) | (0.637) | | | | | | |
| TRADE PAY (5) | 0.181*** | 0.225*** | -0.00543 | -0.0300** | 1 | | | | |
| | (0.000) | (0.000) | (0.580) | (0.002) | | | | | |
| FINANC DEBT (6) | 0.0379*** | 0.212*** | -0.0182 | 0.0143 | -0.172*** | 1 | | | |
| | (0.000) | (0.000) | (0.064) | (0.146) | (0.000) | | | | |
| OPER MARGIN (7) | 0.0295** | 0.194*** | 0.00648 | -0.112*** | 0.00730 | 0.0520*** | 1 | | |
| | (0.003) | (0.000) | (0.508) | (0.000) | (0.456) | (0.000) | | | |
| ASSETS SPEC (8) | -0.211*** | -0.205*** | -0.0225* | 0.00398 | -0.152*** | 0.0553*** | -0.0257** | 1 | |
| | (0.000) | (0.000) | (0.022) | (0.684) | (0.000) | (0.000) | (0.009) | | |
| PROFITABILITY (9) | 0.0321** | 0.194*** | 0.00756 | -0.109*** | 0.00927 | 0.0457*** | 0.909*** | -0.0665*** | 1 |
| | (0.001) | (0.000) | (0.440) | (0.000) | (0.344) | (0.000) | (0.000) | (0.000) | |
| *N* | 10423 | | | | | | | | |