Can financial risk management help prevent bankruptcy?

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ABSTRACT

This paper extends the literature on the relationship between firm risk management and financial distress. It compares the use of financial risk management instruments by firms that eventually file for bankruptcy to matched firms that do not file for bankruptcy between 1994 and 2004. The relation between foreign currency risk management and the probability of bankruptcy is estimated with a duration analysis model, in a framework that controls for the endogeneity problem between the two. The results of this paper show that the odds of filing for bankruptcy are lower for firms that manage foreign currency risk.

Keywords: foreign currency risk, risk management, financial distress, bankruptcy

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INTRODUCTION

In the 2002 Berkshire Hathaway annual report, Warren Buffet warned against the use of derivatives, referring to them as "financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal." Buffet's view on derivatives opposes the commonly held view of academics that derivatives are used to reduce risk (Smith and Stulz (1985)). While most of the concern over the use of derivatives has been expressed by practitioners, two academic studies, Faulkender (2005) and Vickery (2008), show that firms often use interest rate risk management instruments to time the market. Similarly, Brown, Crabb, and Haushalter (2005) find that corporate risk management practices in the gold mining industry are often influenced by attempts to time market prices.

On the other hand, Nance, Smith, and Smithson (1993), Mian (1996), and Hentschel and Kothari (2001) show that the use of derivatives does not cause significant differences in firms' risk, and Fok, Carroll, and Chiou (1997) even find a weak negative relation between the use of derivatives and the probability of bankruptcy. Furthermore, Judge (2006) shows a strong negative relation between the two in a study examining the risk management activity of U.K. firms. He suggests that the relation is stronger for U.K. firms than what was previously found for U.S. firms, and attributes this result to differences in bankruptcy codes. Unlike previous studies that analyze solely the use of derivatives, Judge (2006) uses a broader definition of risk management activity that includes both financial derivatives and hedging methods other than financial derivatives.

This paper examines whether the use of risk management instruments reduces the probability of bankruptcy and provides evidence that foreign currency risk management instruments *are* used for risk reduction purposes. The dataset used is a pair-matched sample of U.S. bankrupt and non-bankrupt companies between 1998 and 2005. A duration analysis model is estimated for the likelihood of bankruptcy as a function of their foreign currency risk management activity, while controlling for the endogeneity arising between the risk management activity and the probability of default, which has been highlighted by several papers. For example, Fehle and Tsyplakov (2005) demonstrate that firms that are either far from financial distress or deep into financial distress have little incentive to initiate or to adjust their use of risk management instruments.

The sample of 344 bankrupt and non-bankrupt firms is restricted to those non-financial and non-utility firms that have available accounting data (from Compustat), as well as risk management information disclosed in their annual reports for at least one year prior to filing for bankruptcy. A firm is considered to be engaging in foreign currency risk management in a particular year if it uses any foreign currency risk management instruments, including both financial derivative instruments and methods other than financial derivatives. For example, a firm is classified as engaging in foreign currency risk management if it reports a debt issue in a foreign currency as a hedging activity under SFAS 133 (Accounting for Derivative Instruments and for Hedging Activities). As Faulkender (2005), Kedia and Mozumdar (2003), and Judge (2006) argue, this approach provides a more accurate picture of a firm's risk management strategy than simply using derivative use to classify firms as engaging in risk management.

The paper focuses on foreign currency risk management, as it is easier to measure and to interpret. For example, Bodnar, Hayt, and Marston (1998) find in a survey that foreign currency derivatives are the most commonly used class of derivatives. Each firm is followed in time, starting with the first year when it discloses its position on foreign currency risk management (this can be as early as 1994) and ending with the fiscal year before bankruptcy filing (this can be as late as 2004).

A discrete time complementary loglog hazard model is estimated for firms' probability to file for bankruptcy within one year. The duration analysis approach is appropriate for this sample and, according to Shumway (2001), performs better than the conditional binary models that are widely used. Since the likelihood of bankruptcy could influence the use of risk management instruments, GMM (Generalized Method of Moments) models are used to control for the endogeneity between the probability of bankruptcy and the foreign currency risk management decision.

The study finds that, all else equal, the odds of filing for bankruptcy are 89.5% lower for firms that manage foreign currency risk as opposed to ones that do not. This result suggests that, the use of foreign currency risk management instruments helps reduce risk and extend a firm's life.

Results are also replicated using a two-stage procedure, where a conditional binary model (logit) is estimated first, to regress the risk management variable on appropriate explanatory variables. Second, the predicted value is included in the cloglog and the linear regression models respectively, along with other accounting-based determinants of the probability of bankruptcy, while using the jackknife method to reduce the bias of the estimator and to produce conservative standard errors. The final results obtained with this approach are very similar. This is also the case for results obtained with a two-stage probit procedure or with a probit with endogenous regressors (methods used in robustness tests).

A word of caution is necessary given that the sample of bankrupt and non-bankrupt firms is a non-random sub-sample of public companies. If risk management is driven by reasons of financial distress and bankruptcy costs, then this sample is biased towards firms where risk management is most desirable. Therefore, caution should be used when making inferences about the impact of risk management on firms' riskiness beyond this sample. However, if financial distress is one of the primary determinants of risk management, then the analysis of bankrupt and non-bankrupt firms is likely to provide the most interesting insights.

Empirical Estimation

For the empirical estimation, a duration analysis model is used, namely a complementary loglog regression, while controlling for the endogeneity arising between the foreign currency risk management activity and the probability of bankruptcy.

The Data

Ideally, the sample would be a large panel of firms observed over a number of years. Unfortunately, the cost associated with hand-collecting the risk management data for a large number of companies is prohibitive. Thus, a pair-matched sample is

constructed. With this sampling method, the sample is conditioned on the probability of bankruptcy, and a bias exists as in any choice-based sample. As argued by Zmijewski (1984), this bias does not affect statistical inference for the bankruptcy model. The results are also qualitatively similar with those obtained when correcting this bias. Finally, the pair matching method provides good controls for the purpose of this study, since the non-bankrupt companies chosen are similar to the bankrupt ones with respect to size and industry. It has been previously used in the bankruptcy literature by Beaver (1966), Altman (1968), Ohlson (1980), and Charitou and Trigeorgis (2002).

First, a list of companies that filed for bankruptcy is collected from BankruptcyData.com, published by New Generation Research Inc. BankruptcyData.com is a Boston-based website that tracks filings from federal bankruptcy districts. After filtering out the private companies, those with total assets of less than $50,000, as well as financial and utilities companies, there are 750 firms that filed for bankruptcy between January 1998 and August 2006 left in the sample.

This time period is used because most companies start disclosing their risk management activities in the footnotes of the annual report filed with the Securities and Exchange Commission (10-K) in 1998. Initially, companies were required by the SEC to adopt SFAS133 (Accounting for Derivative Instruments and for Hedging Activities) in the years beginning after June 1998. The standard, created in an effort to develop a comprehensive framework for derivatives and hedge accounting, required firms to recognize all derivatives as either assets or liabilities in the statement of financial position and to measure those instruments at fair value. The accounting for changes in the fair value of a derivative (that is, gains and losses) depends on the intended use of the derivative and the resulting designation as either fair value hedges, cash flow hedges, or net investment hedges. In June 1999, the FASB delayed the effective date of this statement for one year, to fiscal years beginning June 15, 2000 due to concerns about firms' ability to modify their information systems and educate their managers. However, most firms do not fully implement the new regulation until the quarter ending in June 2001.

The bankruptcy filing companies are restricted to those that have annual reports filed with the Securities and Exchange Commission prior to the bankruptcy filing date, file for bankruptcy only once, and have available Compustat data prior to filing for bankruptcy. Thus, the sample reduces to 447 firms. For this group, searches are run on annual reports on the following keywords: "hedge" or "hedging", "derivative", "financial instrument", "currency", and "exchange rate risk", and then data on whether the firms disclose that they manage their foreign currency risk are manually collected from the footnotes of the annual reports. Only 335 of the firms report the use or non use of risk management instruments for at least one fiscal year prior to the fiscal year of the bankruptcy filing.

Companies that report any type of risk management activity (including but not restricted to the use of derivatives) are assigned a value of one, while the ones reporting no risk management activity, "limited", "minimal", or "immaterial" use of risk management instruments are assigned a value of zero. Companies that ignore the disclosure requirement, or state that the new disclosure regulation did not affect their financial statements are not included in the sample, since no conclusion can be drawn about their risk management involvement. Although notional amounts of financial

instruments used are desirable for this analysis, these are not available in most cases for this particular sample. Thus, the bankruptcy sample consists of 335 firms that filed for bankruptcy between 1998 and 2005. Both accounting and risk management data are typically not available for the fiscal year of the bankruptcy filing, nor after the filing. The earliest year in the sample with reported use of hedging instruments is 1994 and the latest is 2004.

Each company in the bankruptcy sample is matched with a company that (1) did not file for bankruptcy, (2) is in the same industry, and (3) is of similar size (within 10% of asset size) with the bankruptcy filer in the fiscal year prior to its bankruptcy filing. In order to construct the control sample, the two-digit Standard Industrial Classification code is used for the initial matching. If multiple matches exist, the best match is manually selected based on the four-digit or three-digit SIC code, on the closest asset size, and ultimately on the risk management data availability as reported in the annual report filed with the Securities and Exchange Commission. All matches are required to have risk management information reported in their 10-K. Based on these criteria, 172 matches are found. The remaining 163 bankruptcy filers are not matched because of the restrictions on the asset size, and the lack of risk management data. The analysis stops following the 172 matching firms in the same year that their counterparts file for bankruptcy. This creates a censorship issue, which is addressed below. The final sample is comprised of 344 firms (172 bankrupt, and 172 non-bankrupt), and 926 firm-year observations.

The managerial ownership and compensation data are obtained from proxy filings (DEF-14A) with the Securities and Exchange Commission for each of the firms and years in the sample. The accounting data come from Compustat, while the equity data are extracted from CRSP. The return on the S&P 500 index is used as a proxy for the market return.

As detailed in Table 1, 64 out of 344 firms in the sample are concentrated in the business services industry and 50 are in the communications industry. 46 out of 172 bankruptcy filings take place in 2001, and 41 in 2002 (Table 2). The number of bankruptcy filings declines in 2003 and 2004.

To provide a rough picture of the foreign currency risk management activity in the fiscal year before bankruptcy, Table 3 shows that 21% of the bankrupt firms and 29% of the non-bankrupt firms manage their foreign currency risk (the difference is not significant, p-value: 0.12). Similar statistics are shown in the same table for three years before bankruptcy and five years before bankruptcy. Interestingly, the use of foreign currency risk management instruments decreases the closer firms get to bankruptcy filing.

Not surprisingly, a preliminary comparison of the bankrupt versus non-bankrupt companies in the fiscal year before the filing (Table 3) shows that the bankrupt companies have much higher leverage (total debt divided by total assets) than the non-bankrupt companies: 44% versus 31%, p-value: 0.001. They are also characterized by lower liquidity (cash plus short-term investments divided by total assets): 15% versus 21%, p-value: 0.03. Leverage and liquidity are not substantially different for bankrupt firms relative to non-bankrupt firms three or five years prior to bankruptcy.

Empirical Analysis

Numerous papers focus on firm probability of default. One stream of literature emphasizes accounting-based models for default risk which are estimated with measures of firm liquidity, cash flow, solvency, profitability, leverage, size, and efficiency. Also known under the name of credit scoring models, these take the form of Multivariate Linear Discriminant Analysis (MDA) (Beaver (1966), Altman (1968), and Altman (1973)), or of conditional binary probability models (Ohlson (1980) and Zmijewski (1984)). More recent papers, Shumway (2001) and Hillegeist, Keating, Cram, and Lundstedt (2004), argue for the use of hazard models versus static models in bankruptcy forecasting. This is due to duration analysis attempting to model the transition from the state of non-bankruptcy towards the state of bankruptcy, and the relationship between transition patterns and firm characteristics.

To estimate the effect of the use of risk management instruments on the probability of bankruptcy, a discrete time duration model is used in this study. This choice is motivated by both the nature of the data collected, and the advantages of this method over other alternatives. First, the sample is subject to right censorship and left truncation. Second, duration analysis has an advantage over a binary dependent variable model which would not account for the difference in time when the firms file for bankruptcy.

The choice of the particular duration model (complementary loglog hazard model) is motivated by the nature of the information about the spell or the duration length. The duration time is right censored: half of the firms in the sample do not file for bankruptcy, but they are not followed beyond the year that their matched firm files for bankruptcy. It is also subject to left truncation (also known as 'delayed entry'): the sample includes only the years with available data on both Compustat (accounting data), and annual reports (risk management data).

Each firm in the sample is described by a number of time-varying firm-specific variables, for a certain period of time before filing for bankruptcy. This period (spell duration) ranges from 1 to 8 years, with an average of 3 years.

The fiscal year before bankruptcy is the last year with available data in both Compustat and 10-Ks (unless the company emerged from bankruptcy); because of this, it is referred to as the transition year towards bankruptcy.

Although default occurs in continuous time, spell lengths are censored in intervals of 1 to 8 (so called 'grouped' or 'banded' data), where each interval represents one year. Therefore, the hazard function is modeled in discrete time, and a hazard model is used in the form of the complementary loglog model (cloglog), which accounts for interval grouping, left truncation, and right censorship.

The cloglog model has the following form:

$$h_{t,X} = 1 - exp\left[-exp(\beta' X + \gamma_t)\right] \quad (1)$$

where:

$h_{t,X}$ is the hazard rate for year t and depends on the vector X of firm's characteristics.

$\gamma_t = \log\left(\frac{\log S_{0,t-1}}{S_{0,t}}\right)$ where $S_{0,t}$ is the baseline survivor function (the probability of having survived until the end of year t).

The maximum likelihood takes the form:

$$logL = \sum_{i=1}^{n} \sum_{k=u_i+1}^{t} [y_{ik} \log h_{ik,X} + (1 - h_{ik,X}) \log(1 - h_{ik,X})] \quad (2)$$

where:

$y_{ik} = 1$ if firm i makes the transition in year k, and $y_{ik} = 0$ otherwise, u_i is the entry time,

n is the number of firms, and $h_{ik,X}$ is the hazard rate for firm i in year k, and depends on the firm's characteristics (denoted by the vector X).

Estimation Method

The relationship between firms' use of risk management instruments and any measure of firm riskiness or financial distress is most likely subject to an endogeneity problem. For example, Fehle and Tsyplakov (2005) show that firms that are either far from financial distress or deep into financial distress have little incentive to initiate or adjust their use of risk management instruments. More generally, one can think of an omitted variable problem, where unobservable information at the firm level, that affects its decision to hedge, is also related to its probability of bankruptcy.

In order to address this, GMM (Generalized Method of Moments) models are estimated. GMM estimates the model parameters without making strong assumptions about the distributional properties of the variables observed. Thus, it provides a solution to the case where the orthogonality assumption between the error term and regressors is not satisfied. At the same time, it can be readily applied to nonlinear equations, while providing a consistent estimate of the parameters.

Alternatively, the discrete time complementary loglog hazard function is estimated with a two-stage procedure. First, a conditional binary model (logit) is used to regress the risk management variable on appropriate explanatory variables, and second, the predicted value is included in the cloglog regression model along with other accounting-based determinants of the probability of bankruptcy while using the jackknife method to reduce the bias of the estimator and to produce conservative standard errors.

The likelihood of bankruptcy and its determinants

The dependent variable, bankruptcy filing ($Bankruptcy$), is set equal to one in the year in which the transition to bankruptcy takes place, and zero in all previous years.

Foreign currency risk management activity is the independent variable of interest and is also a binary variable, equal to one if the firm manages foreign currency risk and zero otherwise.

The other independent variables have been widely used in the empirical literature on the determinants of bankruptcy. These variables represent firm characteristics[1]:

[1] Some authors argue for a positive relation between firm debt and its probability of bankruptcy (see Fok, Carroll, and Chiou (1997)), while others do not find such a

logarithm of firm size ($Size$), liquidity ($Liquidity$), market to book ratio ($MtoB$), profitability ($Profitability$), industry dummies (i_1 to i_9) to control for industry fixed effects, as well as the number of years that a firm can be found in the sample (Age). While the latter is needed in the cloglog regression, the rest of the control variables used in regressions proxy for the multitude of factors identified by the existing literature as determinants of firm's probability of bankruptcy. For example, since expected bankruptcy costs are related to firm size, smaller firms are more likely to go bankrupt. Thus, a negative relation is expected between firm size ($Size$) and its likelihood of bankruptcy (Warner (1977), and Altman (1984)). Similarly, more liquid firms are less likely to need external financing and thus have a lower probability of bankruptcy (Nance, Smith, and Smithson (1993)). Therefore, liquidity ($Liquidity$) is negatively related to the likelihood of bankruptcy. More profitable firms are less likely, on average, to file for bankruptcy than the less profitable ones. Thus, a negative relation between firm profitability ($Profitability$) and its likelihood of bankruptcy is expected. Firms with higher investment/growth opportunities (e.g. those with a greater market to book ratio ($MtoB$)) are also less likely to file for bankruptcy provided they have available funds to finance these opportunities.

Foreign currency risk management and its determinants

The foreign currency risk management variable (FX_{RM}) equals one if the firm engages in foreign currency risk management and zero otherwise. Some of the variables described above as determining the probability of filing for bankruptcy are also related to firm's risk management activity. For example, we expect a positive relation between firm size ($Size$) and risk management, due to economies of scale. Bigger firms have the necessary infrastructure to implement an appropriate risk management program, as well as the resources to hire risk management specialists (Mian (1996)).

Different studies have argued on the subject of the existence of a relation between leverage and risk management. While Block and Gallagher (1986) and Geczy, Minton, and Schrand (1997) argue that such a relationship does not exist, although most other papers assume it does exist and is positive (Leland (1998) and Purnanandam (2007)). In fact, Purnanandam (2007) argues for a nonlinear relation between the two. Therefore, both leverage ($Leverage$) and leverage squared (Lev) are included on the right side of the risk management regression equation.

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relationship. However, if it exists, this relationship is plagued by endogeneity. Since firms may choose their financing depending on their probability of bankruptcy, adding leverage on the right side of the probability of bankruptcy regression would lead to a simultaneity bias and an inconsistent estimation. To avoid this problem, leverage is not included as an independent variable in the regression. Nevertheless, an eventual inclusion does not alter the conclusion of the paper, nor does it result in statistical significance.

Similarly to risk management, liquidity ($Liquidity$) reduces underinvestment and thus is negatively related to firm risk management activity (Nance, Smith, and Smithson (1993)). Investment or growth opportunities, as proxied by the market to book ratio ($MtoB$), are positively related to risk management (Froot, Scharfstein, and Stein (1993). However, empirical findings from Nance, Smith, and Smithson (1993) and Geczy, Minton, and Schrand (1997) do not agree with this prediction, while Mian (1996)'s results indicate conflicting evidence across different measures used for investment opportunities. A more recent theory paper by Morellec and Smith (2007) argues risk management can control for both underinvestment and free cash flow problems.

In addition, the number of past consecutive years that a firm is found in the sample (Age) is also included to capture its history in managing foreign currency risk, as well as industry dummies (i_1 to i_9) to control for industry fixed effects.

In the GMM estimation, the following exogenous variables (also defined in Table 1) are used for the risk management activity: foreign currency exposure ($Exposure$), the number of stock options awarded to the CEO ($StOptions$), the number of restricted stock awarded to the CEO ($RestSt$), and tax-loss carry forward ($TLCF$).

The higher a firm's foreign currency exposure, the more it is expected to hedge (Adler and Dumas (1984)). The foreign currency exposure variable is estimated as the sensitivity of stock price to the percentage change in the Reuters-Jeffries currency index. Since the same firm can be exposed to multiple sources of risk, the interest rate exposure and the commodity price exposure are also estimated at the same time. The interest rate exposure is the sensitivity of stock price to the percentage change in the interest rate, while the commodity price exposure is the sensitivity of stock price to the percentage change in the Reuters-Jeffries CRB commodity price index. More specifically, all types of exposure (foreign currency, interest rate, and commodity price) are estimated separately for each firm, using five years of monthly data (i.e. sixty months, two years before and two years after the year required), with the following regression:

$$R_{i,t} = \beta_{0i} + \beta_{1i} * R_{mt} + \beta_{2i} * \%\Delta IR_t + \beta_{3i} * \%\Delta FXI_t + \beta_{4i} * \%\Delta CPI_t + \omega_t \quad (3)$$

where:

$R_{i,t}$ is the firm excess return in month t, R_{mt} is the excess market return (S&P500 index) in month t, $\%\Delta IR_t$ is the percentage change in the interest rate in month t, $\%\Delta FXI_t$ is the percentage change in return in month t on the Reuters-Jeffries currency index, and $\%\Delta CPI_t$ is the percentage change in return in month t on the Reuters-Jeffries CRB commodity price index.

Therefore, $\widehat{\beta}_{2i}$ is the estimate for firm i 's foreign currency exposure in the required year.

Alternatively, the ratio of firm's foreign sales on total sales is used as a proxy for the foreign currency exposure. This measure has been suggested by Jorion (1991), as it controls not only for the foreign currency exposure, but also for the economies of scale that take place when managing foreign currency risk.

Smith and Stulz (1985) argue that the more wealth managers have invested in the company (higher managerial ownership) the more they will tend to manage risk. Tufano (1996) shows that a compensation contract that is linear or concave in firm value

provides incentives for the manager to reduce risk, while a convex contract has the opposite effect. Consistent with this argument, he finds that managers of gold mining firms make lower use of risk management instruments if their compensation is based on stock options as opposed to bonuses. Similarly, Rogers (2002) shows that derivative use is negatively related to option holding and positively related to stock ownership.

Lastly, Graham and Smith Jr. (1999) find that tax convexity increases firms' incentives to hedge. However, Graham and Rogers (2002) do not find evidence that firms actually hedge in response to tax convexity. Nevertheless, tax loss carry forward is included in the regressions as a determinant of foreign currency risk management.

RESULTS

Determinants of the likelihood of bankruptcy

The results of the duration analysis GMM estimation are shown in Table 5, regression II. They show a negative and statistically significant coefficient for FX_{RM}, indicating that the likelihood of bankruptcy decreases when firms use foreign currency risk management instruments. To illustrate the economic magnitude of the estimates, the exponential coefficient is calculated for the GMM estimates (regression II), which is equal to 0.105; this suggests that the odds of filing for bankruptcy (within the following year) of a company that uses foreign currency risk management instruments are 10.5% of (or 89.5% lower than) the odds of filing for bankruptcy of a company that does not manage risk. This evidence strongly supports the argument that risk management helps extend a firm's life.

When using the two-stage procedure, results show that, all else equal, the odds of filing for bankruptcy are 85% lower for the firms that manage foreign currency risk as opposed to the ones that do not. Results obtained using both techniques support the argument that firms use foreign currency risk management as a risk reduction technique.

Moving on to the control variables, the estimated coefficients indicate that liquidity has a strong negative impact on the probability of bankruptcy. Thus, the more liquid a firm is, the lower its odds of filing for bankruptcy. Higher profitability is associated with a lower likelihood of bankruptcy. Results also indicate that there is no significant relationship between the odds of filing for bankruptcy and firm size or market to book ratio. The number of years for which a firm has been in the sample, or the firm age, is positively associated with the odds of filing for bankruptcy.

For robustness purposes, two other regression methods are explored: a probit with endogeneous regressors, as well as a two-stage probit procedure. The results of the robustness tests are found in Table 6. Panel A shows the results of the first stage, a probit regression of the risk management variable on the appropriate explanatory variables. Panel B shows the results of the second stage, another probit regression of bankruptcy filing on the predicted value from the first stage and with other determinants of the probability of bankruptcy, while using the jackknife method to reduce the bias of the estimator and to produce conservative standard errors.

These results are very similar (in significance, sign, and magnitude) with those obtained with the GMM procedure. The odds of filing for bankruptcy within the next year of a company that uses foreign currency risk management instruments is 88% to

92.6% lower than the odds of filing for bankruptcy of a company that does not manage risk.

Determinants of the foreign currency risk management

Results from the conditional logit, from the first stage probit regression, and from the first stage probit with endogenous regressors agree in identifying the following determinants of foreign currency risk management activity: firm size, liquidity, profitability, and the number of years a firm is followed (firm age). Results from the conditional logit regression of risk management on its determinants are not reported, but available upon request.

The positive relation between firm size and its probability of managing foreign currency risk can be easily explained by the economies of scale specific to this activity. Liquidity is negatively related to firm probability of managing foreign currency risk, as both of these have been found to reduce underinvestment. As managing foreign currency risk involves relatively high fixed costs, more profitable firms are more likely to engage in this activity as opposed to less profitable ones. A greater number of years in the sample (or a greater age for the firm) indicate that a firm already has the necessary infrastructure in place to manage foreign currency risk and thus it is more likely to do so in the future.

For other variables however, results are inconsistent across different estimations and did not support the theory leading to their inclusion in the regression model. For example, results from the first stage of the probit with endogenous regressors show a negative and significant coefficient for leverage and an insignificant coefficient for leverage square. This result is contrary to the evidence from Purnanandam (2007). Also, results from the two-stage probit procedure show a positive sign for stock options and a negative sign for restricted stock, which does not support the Tufano (1996)'s predictions. Similarly, tax loss carry forwards are negatively related to foreign currency risk management, unlike suggested by Graham and Smith Jr. (1999), but according to the evidence from Graham and Rogers (2002).

CONCLUSION

This paper examines whether the use of foreign currency risk management instruments for a sample of bankrupt and non-bankrupt firms impacts firms' riskiness in terms of their probability of bankruptcy. This relation has not been previously examined in the context of duration analysis.

In a framework that controls for the endogeneity between risk management and the probability of default, the analysis provides evidence that risk management contributes to a lower probability of bankruptcy, which suggests risk reduction and consequently a longer life for the firm.

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Table 1. Definitions. This table presents the definitions for all variables used in the empirical tests.

Variable	Definition
$Bankruptcy$	Binary variable: 1 if the firm files for bankruptcy in the following year and 0 otherwise.
FX_{RM}	Binary variable: 1 if the firm manages foreign currency risk and 0 otherwise.
$RMYears$	Number of years of risk management activity up to that point.
$Size$	Natural logarithm of Total Assets.
$Leverage$	Total debt divided by Total Assets.
Lev	Squared Leverage term (Total debt divided by Total Assets Squared).
$Liquidity$	Cash and Short-term Investments divided by Total Assets.
$MtoB$	Market to Book ratio as reported in Compustat.
i_1 to i_9	Industry dummies.
$Liquidity$	Liquidity as reported in Compustat.
$StOptions$	Natural logarithm of stock options awarded to the CEO.
$RestSt$	Number of shares of restricted stock awarded to the CEO.
$TLCF$	Tax Loss Carry Forward as reported in Compustat.
$Exposure$	Foreign Currency Exposure Variable equal to the value of $\widehat{\beta}_{1i}$ from Equation 3.

Table 2. This table presents a description of the data by industry sector. The first column shows the first two digits of the SIC Code, the second column presents the number of firms for that sector (half of each filed for bankruptcy), and the third column displays the complete name for each sector. (344 observations, 172 pairs).

Sic2	NoObs	Industry
10	2	Metal Mining
13	12	Oil and Gas Extraction
20	2	Food and Kindred Products
22	6	Textile Mill Products
23	4	Apparel and Other Finished Products Made from Fabrics and Similar Materials
26	2	Paper and Allied Products
27	2	Printing, Publishing, and Allied Industries
28	24	Chemicals and Allied Products
30	8	Rubber and Miscellaneous Plastic Products
32	2	Stone, Clay, Glass, and Concrete Products
33	18	Primary Metal Industries
34	4	Fabricated Metal Products, Except Machinery and Transportation Equipment
35	46	Industrial and Commercial Machinery and Computer Equipment
36	30	Electronic and Other Electrical Equipment and Components, Except Computer Equipment
37	4	Transportation Equipment
38	4	Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Watches and Clocks
39	2	Miscellaneous Manufacturing Industries
42	8	Motor Freight Transportation and Warehousing
44	2	Water Transportation
45	4	Transportation By Air
48	50	Communications
50	6	Wholesale Trade-durable Goods
51	6	Wholesale Trade-non-durable Goods
54	2	Food Stores
56	2	Apparel and Accessory Stores
58	8	Eating and Drinking Places
59	8	Miscellaneous Retail
70	2	Hotels, Rooming Houses, Camps, and Other Lodging Places
73	64	Business Services
79	2	Amusement and Recreation Services
80	2	Health Services
87	6	Engineering, Accounting, Research, Management, and Related Services

Table 3. Yearly Data. This table presents a year-by-year description of the data. The second column shows the number of bankruptcies that were filed each fiscal year, while the third column identifies the number of observations in the sample for each fiscal year.

Year	# Bankruptcy Filings	# Observations in the Sample
1994		10
1995		12
1996		20
1997		46
1998	4	122
1999	11	178
2000	20	226
2001	46	174
2002	41	94
2003	29	42
2004	20	2
2005	1	
Total	172	926

Table 4. Means. This table presents means of firm characteristics for companies that filed for bankruptcy and the control group. Statistics are shown for the fiscal year before bankruptcy filing, for three years before filing for bankruptcy, and for 5 years before filing for bankruptcy. The variables shown are: foreign exchange risk management (FX_{RM}), leverage ($Leverage$), and liquidity ($Liquidity$).

Characteristic	Year Before Filing	
	Bankrupt Group	Control Group
FX Risk Management	21.64%	29.85%
Leverage	44.79%	31.18%
Liquidity	15.76%	21.85%

Characteristic	3 Years Before Filing	
	Bankrupt Group	Control Group
FX Risk Management	38.09%	34.92%
Leverage	35.86%	30.77%
Liquidity	15.77%	21.08%

Characteristic	5 Years Before Filing	
	Bankrupt Group	Control Group
FX Risk Management	45.83%	41.67%
Leverage	25.63%	29.18%
Liquidity	18.29%	18.76%

Table 5. Complementary LOGLOG. This table presents the regression coefficients, the exponential coefficients, and the p-values from the cloglog regression of bankruptcy filing on the risk management activity, firm-specific covariates, and industry dummies. The three columns represent two different empirical estimations of the cloglog regression. I is a two-stage procedure where the 1st stage is a conditional logit regression of risk management on its determinants, and the 2nd stage is the cloglog regression of bankruptcy filing on the predicted value from the 1st stage, and other determinants of the probability of bankruptcy, while using the jackknife method to reduce the bias of the estimator and to produce conservative standard errors. II is the Generalized Method of Moments (GMM) estimation of the cloglog regression. The dependent variable is the bankruptcy filing (0 or 1). Industry dummies are also included in the regression, but not reported in this table.

	I			II		
Variable	Coef.	Exp. Coef.	P-value	Coef.	Exp. Coef.	P-value
FX Hedge	-4.191***	0.015	(0.00)	-2.257**	0.105	(0.02)
Size	0.158	1.171	(0.28)	0 .008	1.008	(0.96)
MtoB	-0.001	0.999	(0.75)	-0.001	0.999	(0.63)
Liquidity	-3.050***	0.047	(0.00)	-2.529**	0.080	(0.02)
Profitability	-0.403***	0.668	(0.00)	-0.883***	0.414	(0.01)
Age	0.899***	2.457	(0.00)	0.878***	2.406	(0.00)
Const	-5.938***		(0.00)	-5.027***		(0.00)

*, **, and *** represent significance at the 10%, 5%, and 1% level respectively.

Table 6. Robustness Check. This table presents the coefficients, the exponential coefficients, and the p-values from the regression of foreign currency risk management activity on its determinants. The two columns represent two different empirical estimations. II is a probit regression of risk management on its determinants. II is a probit with endogenous regressors. *Panel A* is the first stage where the dependent variable is foreign currency risk management activity (0 or 1). *Panel B* is the second stage where the dependent variable is the likelihood of bankruptcy. Industry dummies are also included in the regression, but not reported in this table.

	I			II		
Variable	Coef.	Exp. Coef.	P-value	Coef.	Exp. Coef.	P-value
Panel A.	*Dependent variable is foreign currency risk management (FX_RM).*					
Size	0.317***	1.373	(0.00)	0.102***	1.107	(0.000)
MtoB	-0.0003	0.999	(0.77)	-0.00004	0.999	(0.78)
Liquidity	-1.265***	0.282	(0.01)	-0.325***	0.722	(0.00)
Profitability	1.198***	3.315	(0.00)	0.079	1.082	(0.10)
Age	.306***	1.358	(0.00)	0.080***	1.084	(0.00)
Leverage	-1.193	0.303	(0.24)	-0.415***	0.660	(0.00)
Lev	-0.254	0.776	(0.84)	0.103	1.109	(0.11)
StOptions	0.034**	1.035	(0.01)	0.004	1.004	(0.25)
RestSt	-0.060**	0.942	(0.01)	-0.009*	0.991	(0.05)
TLCF	-0.002**	0.998	(0.02)	-0.0002***	0.999	(0.00)
Exposure	-0.003	0.997	(0.77)	0.001	1.001	(0.66)
Const	-3.724***		(0.00)	-0.542***		(0.00)
Panel B.	*Dependent variable is the likelihood of filing for bankruptcy (Bankruptcy).*					
Size	0.089	1.093	(0.31)	0.099	1.105	(0.11)
MtoB	-0.001	0.999	(0.68)	-0.001	0.999	(0.80)
Liquidity	-1.731***	0.177	(0.00)	-1.206***	0.299	(0.00)
Profitability	-0.308	0.735	(0.20)	-0.170	0.843	(0.37)
Age	0.577***	1.780	(0.00)	0.412***	1.509	(0.00)
Constant	-3.335***		(0.00)	-2.453***		(0.00)

*, **, and *** represent significance at the 10%, 5%, and 1% level respectively.