Leverage, Competition and Financial Distress Hazard: Implications for Capital Structure in the Presence of Agency Costs

Abstract

Does leverage or product-market competition increase or decrease financial distress risk? The existing literature provides conflicting and largely a-theoretical answers. Drawing on agency theory, we hypothesize that leverage and competition are incentive-alignment mechanisms with non-monotonic and substitute effects on financial distress hazard. Using an unbalanced panel of 13,896 listed firms from 1992-2014 and a multi-level hazard model that takes account of frailty and endogeneity, we find that leverage or competition have a *hazard-reducing* effect when the discipline effect dominates the agency-cost effect. In contrast, they have a *hazard-increasing* effect when the discipline effect dominates the agency-cost effect. Furthermore, the level of leverage that minimizes financial distress risk is higher in less competitive industries. Finally, long-term debt is a stronger disciplining device compared to short-term debt; and the financial distress predictors widely used in the literature explain only a small fraction of the distress hazard after controlling for leverage and competition.

Keywords: Financial distress; competition; leverage; hazard modelling.

JEL classification: C23; C25; C41; G30; G33.

1. Introduction

The cost of firm failure for creditors, shareholders, and employees has given rise to a large body of literature that assesses the predictive value of the firm performance indicators such as solvency, liquidity, and profitability measures (Altman, 1968; Taffler, 1984; Shumway, 2001; Bauer and Agarwal, 2014; Altman et al., 2017). Although less frequently, other studies have also investigated the predictive value of industry- and country-level performance indicators such as intra-industry growth volatility or the phase of the business cycle (e.g., Koopman and Lucas, 2005). Yet, the research effort has so far remained largely *a-theoretical* (Gupta et al., 2018) as the causal channel(s) through which the firm- or industry-level indicators affect financial distress hazard remain poorly specified.

In this study, we address this knowledge gap with respect to two predictors of financial distress risk investigated widely in the empirical literature: the level of debt relative to total assets (leverage) and the level of product-market competition. Drawing on the agency theory of leverage (Jensen and Meckling, 1976; Grossman and Hart, 1982; and Myers, 2001) and competition (Holmstrom, 1982; Nalebuff and Stiglitz, 1983; Aghion et al., 1999b, 2002; and Backus 2020), we hypothesize that leverage or competition are incentive-alignment (discipline) instruments with two opposite effects on financial distress hazard. On the one hand, they have a hazard-reducing *discipline effect* when they increase the incentives for managers to exert effort. On the other hand, they have a hazard-increasing *agency-cost effect* when they exacerbate the agency conflicts and reduce managerial effort. Because the balance between the *discipline* and *agency-cost* effects differs at different levels of leverage and competition, we demonstrate that the effects on financial distress hazard are non-monotonic in a cross section of firms faced with different levels of leverage and product-market competition.

The discipline and agency-cost effects of leverage unfold through various channels. First, leverage reduces the scope for managerial slack by requiring the manager to work harder to repay the debt and the interest cost (Jensen and Meckling, 1976; Harris and Raviv, 1991; Myers, 2001). It also reduces managerial slack by increasing the stringency of creditor monitoring (Denis and Wang, 2014). Leverage can also induce higher managerial effort by increasing the pressure on managers to avoid bankruptcy and the concomitant adverse effects on their future earnings and reputation (Grossman and Hart, 1982; Jensen, 1986). Nevertheless, leverage can also increase the agency cost of debt. This will be the case if shareholders are induced to shift the risk of debt to

debtholders. In this case, debt-financing may increase the risk of financial distress as managers are under less pressure to perform and the interest cost of debt increases as creditors require a higher risk premium.

The effects of product-market competition also unfold through different channels. On the one hand, competition provides additional information to shareholders to compare the manager's unobservable effort with other firms and set the remuneration of the managers accordingly (Holmstrom, 1982; Nalebuff and Stiglitz, 1983). This discipline effect of competition induces managers to align their incentives with shareholders and exert higher levels of effort (Hermalin, 1992), leading to higher levels of firm productivity and profitability (Hart, 1983; Nickell, 1996; Backus, 2020). However, Hermalin (1992) also demonstrates that competition may exacerbate the agency conflicts if the marginal cost of extra effort required to cope with competitive pressure dominates the marginal benefits of higher incomes received for extra effort. Therefore, the overall effect of competition on financial distress risk also depends on the balance between *discipline* and *agency-cost* effects of competition, which differs at different levels of competition.

Given this setup, we hypothesize that the effects of leverage and competition on financial distress risk are non-monotonic: the effect of leverage is inverted-U-shaped (***H1***) whereas that of competition is U-shaped (***H2***). The effect of leverage is inverted-U-shaped because the agency-cost effect dominates and the firm is in a *shirking regime* when debt increases from a low initial level; but it is in a *bonding regime* and the discipline effect dominates when debt increases from high initial level (Aghion et al., 1999a; 1999b). At low initial levels of debt, the agency-cost effect dominates for three reasons. First, the cost of borrowing is relatively low and there is less pressure on the manager to work harder and pay the interest expenses. Secondly, the perceived risk of bankruptcy is low and hence the manager is under less pressure to reduce the risk of income or reputational losses.[1] A third reason relates to creditor monitoring, which tends to be light-touch when the firm's leverage is relatively low. As a result, the financial distress risk *increases* with leverage when the firm is in a shirking regime due to a low initial level of debt. This hazard-increasing effect continues to hold until the level of leverage is high enough to induce higher managerial effort and stricter creditor control. After this threshold is exceeded, the firm enters a bonding regime; managerial effort increases; and the financial distress risk *decreases* with leverage. In a cross-section of firms with different levels of leverage, some firms will be in a

[1] This is similar to findings in earlier work, where managerial slack is higher at low levels of debt finance (Myers, 1977).

shirking regime whilst others in a bonding regime. As a result, the relationship between leverage and financial distress hazard will have an inverted-U shape, indicating that the financial distress risk is increasing with leverage at low initial levels where the agency-cost effect of debt dominates, but it is decreasing with leverage at high initial levels where the discipline effect dominates the agency-cost effect.

In contrast, the relationship between product-market competition and financial distress risk is U-shaped. This is again due to the changing balance between the discipline and agency-cost effects of a given increase in competition. When the initial level of competition is low, the discipline effect dominates the agency-cost effect; and financial distress hazard falls as competition increases. In contrast, the agency-cost effect dominates the discipline effect and financial distress hazard increases with competition. The causal mechanism at work is similar to Hermalin (1992), where the effect of competition on managerial effort and firm performance depends on the balance between the income effect that encourages managerial effort and the cost effect that reduces managerial effort. At low initial level of competition, the discipline effect dominates because the cost of extra managerial effort required to reverse the profit-diluting effect of higher competition is small. In contrast, the agency-cost effect dominates when the initial level of competition is high, the returns on extra effort are less certain, and the managers are less incentivised to exert effort. Applied to a cross-section of firms faced with different levels of competition, this changing balance between the discipline and agency-cost effects implies that a given increase in competition reduces financial distress hazard for firms in less competitive industries but increases financial distress for those in highly competitive industries.

Finally, the agency-theoretic literature suggests that leverage and product-market competition are substitute incentive-alignment mechanisms when firms are faced by agency conflicts (Aghion et al., 1999b; 2002). We formulate this insight as our third hypothesis (***H3***), which states that, in the presence of agency conflicts, leverage and competition are substitutable disciplining devices. ***H3*** implies that firms should increase leverage with a view to reduce financial distress risk when the firm is in a low-competition industry, where managerial slack is more likely. However, they should reduce leverage when the firm is in a highly competitive industry, where the cost of managerial effort is high and/or returns on managerial effort are low.

We test the three hypotheses summarised above by utilising a multi-level hazard model that takes account of frailty and reverse causality. Although taking account of frailty is a common practice in hazard models in general, only Gupta et al. (2018) have recently addressed this issue in

the context of financial distress hazard models by allowing for frailty as a multiplicative random effect in an extended Cox model with time-varying covariates. This is a welcome step but does not address the implications of frailty or reverse causality for potential endogeneity. Frailty is an unobserved, firm-specific susceptibility to financial distress. It is a potential source of endogeneity if it is correlated with the predictors of the financial distress hazard. We address this potential source of endogeneity by augmenting the multi-level hazard model with Mundlak (1978) corrections, which consist of augmenting the hazard model with within-firm averages of the financial distress predictors as additional regressors. We also conduct robustness checks to verify whether endogeneity is a problem due to reverse causality between leverage and duration on the one hand, and the firm's observed distress status on the other.[2] To do this, we regress the *observed* values of leverage and duration on firm- and industry-level covariates to obtain *predicted* values that are independent of the firm's financial distress history.[3]

Our analysis offers several contributions to the existing research effort. First, we demonstrate that financial distress is essentially a managerial effort (or incentive alignment) problem that can be mitigated by choosing the optimal level of debt given the level of product-market competition. Our second contribution is to show that, in the presence of agency conflicts, it is necessary to control for both non-monotonic and interactive leverage and competition effects. Failure to do this may lead to model misspecification bias, which is likely to affect the estimates from monotonic hazard models that also overlook the interaction between leverage and competition. Our third contribution is to demonstrate that, in the presence of agency conflicts, the optimal level of leverage that minimizes the firm's financial distress risk is higher (lower) in less (more) competitive industries. Fourth, our model estimates take account of frailty and potential endogeneity; and indicate that the accounting- and/or market-based predictors widely used in current empirical models explain only a small fraction of the financial distress risk after controlling for quadratic and interactive leverage and competition effects. Finally, we contribute to the debate on whether short- or long-term debt is more effective in disciplining managers by demonstrating that the discipline effect of leverage is due to long-term rather than short-term debt.

We organise the rest of the paper as follows. In section 2, we discuss the extent to which the empirical literature remains *ad hoc* with respect to predictor selection and the treatment of frailty

[2] We treat competition as externally determined at the industry level, as discussed in the methodology section.
[3] This procedure reduces the risk of reverse causality by eliminating the correlation between the predicted values of the financial distress predictors and the idiosyncratic error term of the hazard model.

and endogeneity. In section 3, we synthesize the insights from the agency-theoretic literature to demonstrate that leverage and product-market competition are substitute disciplining devices with non-monotonic effects on financial distress hazard. In section 4, we introduce our dataset, obtained from Thompson Reuters' *Worldscope* database. The estimation sample consists of 13,986 firms listed in 12 developed and emerging markets. Then, we discuss how the dynamic hazard model - proposed by Shumway (2001) and evaluated by Bauer and Agarwal (2014) - can be extended to take account of: (i) recurrent events and frailty at the firm level; (ii) endogeneity due to a potential correlation between frailty and financial distress predictors through Mundlak (1978) corrections; and (iii) endogeneity due to reverse causality between financial distress hazard and its predictors. Our findings are presented in section 5 and the Appendix. We conclude in section 6 by discussing the implications of our findings for business decision-making and for future research.

2. Related Literature and Implications for Modelling

Empirical work on bankruptcy prediction began in the 1960s with Altman's (1968) discriminant analysis based on the Z-score. This was followed by Taffler (1984) and Zmijewski (1984), who utilised accounting variables such as profitability (net income to total assets), leverage (total debt to total assets), and liquidity (current assets to current liquidity) as bankruptcy predictors. The discriminant analysis has informed a large volume of empirical work, evaluated in Altman et al. (2017). However, Shumway (2001) questioned its static setup, which may lead to biased estimates due to disregarding duration (the time-to-failure-event) as a potential determinant of financial distress hazard. Using dynamic hazard models and data for US firms from 1962-1992, Shumway (2001) demonstrates that the latter outperforms the static models; and that models with both accounting and market variables are better than those based on accounting variables only. These findings have been confirmed in later reviews by Campbell et al. (2008) and Bauer and Agarwal (2014).

The accounting- and market-based predictors investigated in the existing literature vary between studies, but can be grouped into four categories: (i) solvency indicators such as total funds from operations as a ratio of total debt, total debt as a ratio of total assets (leverage), and earnings before interests as a ratio of interest expenses (coverage); (ii) liquidity measures such as cash and short-term investment as a ratio of total assets; (iii) profitability indicators such as earnings before interest, taxes, depreciation and amortization as a ratio of total assets; and (iv) market-based

performance indicators such as share price, excess returns, and return volatility (see, Bauer and Agarwal, 2014; Gupta et al., 2018).

We have reviewed more than 50 empirical studies where leverage or competition is included in the model as a financial distress predictor. One key issue we have identified is the disconnect between theory and empirical models. The attention remains focussed on model performance, with little or no elaboration on the causal channels through which the predictors affect the risk of financial distress. A second issue is potential model misspecification due to *ad hoc* modeling of leverage and competition. In studies based on non-banking firm data, leverage is usually modeled as a linear predictor of financial distress hazard, but without controls for competition or non-monotonic effects. In studies based on banking data, on the other hand, competition is modeled with monotonic effects but without controlling for leverage. Finally, none of the studies in either cluster control for interaction effects between leverage and competition, in contradiction with the agency theory where leverage and competition may be substitute or complementary incentive-alignment devices depending on the level of agency conflicts. A third issue concerns the lack of attention to frailty and potential endogeneity, with notable exception of Gupta et al. (2018), where frailty is modelled as a multiplicative term without discussing its implications for endogeneity.

A fourth issue arises from conflicting findings on the effects of leverage or competition. In two-thirds of 30 studies that control for leverage, the latter increases financial distress hazard (e.g., Platt and Platt, 2006; Campbell et al., 2008; Tinoco and Wilson, 2013; and Gupta et al., 2018). In the remaining one-third, the effect is negative or insignificant (e.g., Altman and Sabato, 2007). Although the hazard-increasing effect of leverage is explained by higher debt servicing costs (e.g., Tinoco and Wilson, 2013), the hazard-reducing or insignificant effects remain unexplained.

The picture that emerges from more than 20 studies based on banking data is similar. Most studies control for competition without controlling for leverage (e.g., Beck et al., 2013; Cipollini and Fiordelisi, 2012). Some studies report that market power (i.e., absent or low competition) is associated with lower risks of bank failure or financial fragility (Berger and Hannan, 1998; Berger et al., 2009; Cipollini and Fiordelisi, 2012)[4]. Others report that market power is conducive to higher risks (e.g., Uhde and Heimeshoff, 2009).

[4] In this literature, the hazard-reducing effects of competition are explained by: (i) higher market power leading to higher profits that can be used to build capital buffers and reduce failure risk; (ii) higher charter values in larger banks that deter excessive risk-taking; (iii) better credit monitoring and rationing by larger banks; and (iv) better portfolio diversification by larger banks.

Beyond conflicting findings and the risk of model misspecification, the existing work usually does not provide a theoretical framework that would allow for causal inference. This is usually the case, except for some studies that refer to competition-fragility and competition-stability theses in the literature on bank failures (see, Allen and Gale, 2004). As observed by Gupta et al. (2018), the largely *a-theoretical* drive is due to the limited focus on model performance at the expense of causal mechanisms. We aim to address this oversight by drawing on agency theory, which demonstrates that the causal effects of leverage and competition on financial distress risk are due to the extent to which they mitigate or exacerbate the agency conflicts. This agency-theoretic approach takes into account: (i) the extent to which the manager is risk-averse (Hart, 1983; Scharfstein, 1988); (ii) the variation in the balance between the *discipline* and *agency-cost* effects at different levels of leverage or competition (Grossman and Hart, 1982; Jensen, 1986; Hermalin, 1992); and (iii) the way in which this balance depends on the initial levels of leverage and competition (Aghion et al., 1999a, 1999b; Hermalin, 1992 and Schmidt, 1997).

Another issue that remains below the radars of the existing work is frailty and potential endogeneity. As noted by Gupta et al. (2018), frailty is a largely neglected issue in empirical work on financial distress hazard. Yet, firms are likely to experience multiple financial distress events and the latter may be clustered by firms or industries. If such clustering exists, it is necessary to model frailty explicitly and verify whether it is correlated within firms and/or industries. Overlooking frailty in hazard models is possible only if one assumes that all firms are homogeneous in their susceptibility to financial distress; and that the duration (i.e., the time-to-failure) is not correlated within firms over time or between firms in the same industry (Gupta *et al*., 2018: 440).

Instead of relying on such an untested assumption, we allow for frailty at the firm and industry levels and test for its presence in two ways. First, we exploit the flexibility of the multi-level models, which allow for random effects at the firm and industry levels. Depending on whether the random effects are at the industry or firm levels or both, we augment the hazard model with Mundlak (1978) corrections, which consist of within-firm or within-industry averages of the regressors. This procedure ensures that frailty is mean-independent of the regressors and hence the hazard rate estimates are not biased due to what we call *type-1 endogeneity*. We also test whether a *type-2 endogeneity* may exist due to reverse causality between the financial distress event and the regressors in the hazard model. For this, we rely on predicted values of the regressors, which are obtained after controlling for the firm- and industry-specific determinants of leverage and

duration.[5] This is similar to an instrumental variable (IV) estimation procedure, except that the estimation is carried out in two steps. In step 1, we obtain the predicted values of the regressors, and in step 2, we use these predicted values in the hazard model to verify if controlling for endogeneity alters the sign and/or significance of the hazard rate estimates[6].

3. Back to Theory: Leverage and Competition as Incentive-alignment Devices

In this section, we draw on agency theory, where financial distress risk has been analysed as an agency problem since the seminal contribution by Jensen and Meckling (1976). In this perspective, the more severe the agency problem is, the lower is the managerial effort and firm performance, and the higher is the financial distress risk. Nevertheless, the severity of the agency problem or the level of managerial effort is *unobservable*. Hence, the utility of the agency theory stems from its predictions about some *observable* incentive-alignment (discipline) mechanisms that mitigate or exacerbate the agency conflicts, induce higher or lower managerial effort and hence reduce or increase the financial distress risk. Two potential candidates that satisfy this property are the firm's capital structure (i.e., its leverage) and the level of product-market competition that the firm is faced with.[7]

According to the control hypothesis of debt creation (Jensen, 1986), leverage can act as a commitment device that mitigates the agency problem and reduce the risk of bankruptcy at the same time. Here, leverage can act as a substitute disciplining device that corrects for weak product-market competition or corporate governance, or both. An increase in leverage induces the manager to increase effort, improve organizational efficiency, and reduce the risk of bankruptcy. The implication for capital structure theory is that the more severe the agency problem is, the higher is the *optimal level* of leverage.

Nevertheless, higher levels of leverage may also increase the risk of financial distress due to increased cost of debt servicing, lower levels of future investment that reduce the firm's value, and the exacerbation of the agency conflicts between bondholders and shareholders (Jensen and

[5] We treat competition as exogenous, given that it is determined externally at the industry level.

[6] It must be noted here that the two-step IV estimation we rely on is less efficient than the two-stage least square (2SLS) estimator, where the instrument and outcome equations are estimated simultaneously to take account of the correlation between the errors in both parts of the model (Wooldridge, 2010). However, the simultaneous estimation is feasible only if the two parts of the model are linear. Given that the outcome model here is non-linear, we rely on sequential estimation that trades off efficiency for consistency.

[7] The effects of a third incentive-alignment mechanism - corporate governance rules – are not analysed here due to the existence of a rich literature on corporate governance and financial distress hazard, reviewed by Habib et al. (2020).

Meckling, 1976; Myers, 1977). Hence, the overall effect of leverage on financial distress depends on the balance between the hazard-reducing effect due to mitigation of the agency problem and the hazard-increasing effect due to higher agency costs of debt. A similar result is derived in Grossman and Hart (1982), where the overall effect of leverage depends on the balance between the profitability of the investment projects (i.e., the increase in managerial effort) and the cost of debt.

Ambiguity about the leverage's effect on managerial effort and financial distress hazard can be resolved by considering the initial level of leverage, as demonstrated by Aghion et al. (1999a; 1999b). In the presence of agency conflicts, a leveraged firm can be either in a 'binding' or 'shirking' regime, depending on the initial level of debt. The firm is in a *shirking regime* when debt increases from a low initial level. This is because, in this state, the capacity for securing external finance is less of a concern, and the scope for managerial slack is relatively high.[8] In contrast, the firm is in a *bonding regime* when the initial level of debt is high, and the manager is under pressure to work harder to repay creditors and reduce the risk of bankruptcy. These predictions hold when the firm is considered on its own or when it interacts with other firms in an oligopolistic environment.

The hazard-reducing effects of debt financing at high initial levels of debt is also in line with findings in Dewatripont and Tirole (1994), who demonstrate that the firm's capital structure is a disciplining device in the presence of agency conflicts that cannot be resolved through contracting[9]. In this line of work, the control rights of debtholders emerge as an additional source of discipline for the managers. As debt increases, debtholders are more likely to assert their control rights in two ways. On the one hand, they require a higher level of income streams that would compensate for their exposure to higher risks of firm failure. On the other hand, they become more likely to exercise 'hard control' after bad news about firm performance. Overall, debtholders are more likely to take control and act as 'tough principals' in bad times, complementing the discipline effect of shareholder control during good times.

These insights from the agency-theoretic work indicate that the balance between the *discipline* and *agency-cost* effects of leverage differs at different levels of debt. At low levels of

[8] This is similar to findings in earlier work, where managerial slack is higher at low levels of debt finance (Myers, 1977).

[9] The empirical evidence show that despite the adverse effects of high debt, better management enables more effective use of innovation even during stressful times (Nemlioglu and Mallick, 2020; 2021).

debt, the agency-cost effect dominates the discipline effect as the firm is in a shirking regime. In this state, the financial distress hazard increases with leverage. In contrast, financial distress hazard decreases with leverage when the initial level of debt is high, and the firm is in a bonding regime. In a cross-section of firms with heterogenous levels of leverage, therefore, the relationship between leverage and financial distress hazard is inverted-U-shaped. Hence, we postulate our first testable hypothesis (**H_1**) as follows:

> **H_1***: The effect of leverage on financial distress is inverted-U-shaped: the hazard rate increases with leverage when leverage increases from a low initial level but decreases with leverage when leverage increases from a high initial level.*

To the best of our knowledge, this is the first attempt at investigating whether leverage has a non-monotonic discipline effect on financial distress hazard. Although the proposed approach is novel in the context of hazard modelling, it is indeed congruent with empirical findings indicating that: (i) survival time is longer among new firms entering the market with higher levels of debt (Cole and Sokolyk, 2018); and (ii) debt has a disciplining effect on managers and is associated with higher innovation efforts among firms with more severe agency problems (Czarnitzki and Kraft, 2009). It is also in line with Denis and Wang (2014), who investigated a large sample of private debt renegotiations from 1996 to 2011 and report that creditors have played a significant control role over borrowing firms before the latter enter a financial distress state. Finally, it is congruent with Harvey et al. (2004), who utilize data on emerging-market firms and report that the positive effects of debt on firm performance is concentrated among firms with severe agency conflicts and over-investment problems.

The second hypothesis we develop relates to non-monotonic discipline effects of product-market competition. In Holmstrom (1982) and Nalebuff and Stiglitz (1983), competition provides additional information about the manager's performance relative toother firms. In this setting, shareholders set the manager's compensation as a function of her/his relative performance. In turn, the manager trades off the increase in earnings with the increased cost of effort. Competition is conducive to higher effort and better firm performance if it increases the cost of shirking more than the cost of higher effort.

In contrast, Hart (1983) proposes a hidden information model, where firms are faced with a common shock transmitted via market price and the manager's compensation depends on the firm's own profits rather than relative profits. Assuming that managers are infinitely risk-averse,

Hart (1983) demonstrates that increased competition would always induce higher effort; and the effort will be higher as both product-market and input-market competition increases. When managers are risk-neutral, however, competition would always reduce effort and firm performance (Scharfstein, 1988).

Conflicting results in Hart (1983) and Scharfstein (1988) raises the question of whether the conflict can be resolved when the initial level of competition is considered, and one remains agnostic about the degree of risk aversion on the manager's part. One answer is due to Hermalin (1992), who distinguishes between three effects of competition on managerial effort: an income effect, a risk-adjustment effect, and a relative-value-of-actions effect. The *income effect* is similar to Hart (1983): increased competition induces the manager to exert higher effort to maintain firm profits and her/his own income. The *risk-adjustment effect* is similar to Holmstrom (1982) and Nalebuff and Stiglitz (1983) as it depends on the relative risks associated with shirking and higher effort. Finally, the *relative-value-of-actions effect* reflects the increased competition's effect on the expected utility of the manager. This effect can be either positive (which would augment the positive income effect) or negative (which would dampen or reverse the positive income effect).

Hermalin (1992, p. 356-357) demonstrates that the relative-value-of-actions effect complements the income effect and managerial effort increases when the manager is faced with increasing returns to effort. This is more likely when the initial level of competition is low. At low initial levels, competition is conducive to higher returns to effort because the competition-induced firm efficiency, the accompanying increase in firm value, and the improvement in the performance-related managerial wage are all obtained at lower costs in terms of reduced market power. When the initial level of competition is high, however, the returns to cost reduction fall with higher competition, and the relative-value-of-actions effect is negative. Hence, the relationship between competition and managerial effort is non-monotonic: an increase in competition from a low initial level is associated with higher managerial effort whereas an increase in competition from a high initial level is associated with lower managerial effort.

A similar conclusion is derived by Schmidt (1997), who demonstrates that the effect of competition on managerial effort and financial distress risk depends on the balance between two opposing effects: (i) a *disciplining effect* that induces managers to exercise higher effort to avoid bankruptcy; and (ii) a *profit-diluting effect* that reduces the value of cost reduction for the principal, who would be less willing to incentivize the manager through a compensation level above the latter's reservation utility. The disciplining effect of competition dominates until an intermediate

level, up to which managerial effort increases and financial distress risk falls with competition. Beyond that threshold, the profit-diluting effect dominates, managerial effort falls, and financial distress risk increases with the increasing competition.[10] Given these theoretical predictions in Hermalin (1992) and Schmidt (1997), we state our second hypothesis (H2) as follows:

> ***H_2**: The effect of competition on financial distress hazard is U-shaped: the hazard rate decreases with competition at low initial levels where the disciplining effect of competition dominates but increases with competition at high initial levels where the profit-diluting effect dominates.*

Naturally, and perhaps inevitably, the analysis above raises the question of whether the discipline effects of leverage and competition are complementary or substitutes. This question is discussed in Aghion et al. (1999b), who incorporate agency considerations into a Schumpeterian growth model with competition, innovation, and debt accumulation. In that work and in Aghion et al. (2002), product-market competition, leverage, and corporate governance quality are substitutable incentive-alignment mechanisms if agency conflicts exist. When the mechanisms are complementary, both mechanisms must be adjusted to obtain an optimal level of alignment between managerial and shareholder incentives. When the mechanisms are substitutable, however, the shareholders (principals) can manage agency conflicts by adjusting one mechanism to correct for incentive misalignment caused by the existing level of the alternative mechanism. If, for example, the externally given level of competition is too low or too high to induce the manager to act as a profit maximiser, leverage can be adjusted to reduce managerial slack, speed up innovation and growth, and hence reduce the risk of financial distress. Hence, we state our third hypothesis (H3) as follows:

> ***H_3**: In the presence of agency conflicts, leverage and competition are substitute disciplining devices such that an increase in leverage reduces the financial distress associated with the level of competition in the industry.*

Given the central role that the agency problem plays in the analysis above, we use two proxies of the unobservable managerial effort to verify if agency costs exist and are correlated with financial distress risk: the ratio of operating expenses to net sales (*OPEX/SALES*) and the ratio of

[10] As stated in Schmidt (1997, p. 194), "… starting from a monopoly, managerial effort increases when we move to a duopoly, but will eventually decrease as additional competitors enter the market."

net sales to total assets (*SALES/ASSET* ratio). The first is a *managerial slack proxy* in that the higher is the *OPEX/SALES* ratio, the lower is the managerial efficiency. The second is a *managerial effort proxy* in that the higher is the *SALES/ASSET* ratio, the more effective the manager is in deploying the firm's assets to generate sales revenue (Ang et al., 2000; Garanina and Kaikova, 2016). Both measures are in line with the conceptual construct in Jensen and Meckling (1976); and have been used in empirical work by Ang et al. (2000), Garanina and Kaikova (2016), and others.

4. Data and Methodology

Our data is from Thompson Reuters' *Worldscope* database, which provides financial statement and profile data. *Worldscope* data collection templates take account of variation in accounting conventions and are designed to facilitate comparisons between firms within and across countries (Worldscope, 2013). The variables are defined in *Table A1* in the *Appendix.*

We use early-warning indicators of financial distress events (FDEs) rather than legally defined indicators such as bankruptcy events. The advantage of the legal FDE indicators is certainty. However, more recent work argues in favour of early-warning FDE indicators for three reasons. First, often a significant time gap exists between 'economic' and 'legal' default dates, which can be up to three years depending on the legal regime. Second, bankruptcy law provisions differ between countries, and this raises comparability issues. Third, early warning indicators are good approximations to true bankruptcy in the population (Platt and Platt, 2006). Finally, they provide useful information for remedial action aimed at reducing the risk of eventual failure (Pindado et al., 2008; Tinoco and Wilson, 2013; Keasey et al., 2015; Gupta et al., 2018). For these reasons, we provide estimations based on three *early-warning FDEs* defined below:

- *FDE1 = 1* if the interest coverage ratio (EBIT/interest expense on debt) is less than 0.8 and market value growth is negative for two consecutive years, and 0 otherwise. This FDE indicator has been used by Pindado et al. (2008), Platt and Platt (2006), Tinoco and Wilson (2013), Inekwe et al. (2018), and Fernández-Gámez et al. (2020).
- *FDE2 = 1* if EBITDA is less than interest payment, EBIT is negative and Net Income is negative for 2 consecutive years, and 0 otherwise. This indicator has been used by John, Lang, and Netter (1992), Pindado et al. (2008), Plat and Plat (2006), and Keasey et al. (2015).

- *FDE3 = 1* if EBITDA is less than financial expenses, the net worth/total debt ratio is less than one, and the net worth growth is negative for two consecutive years; and 0 otherwise. This indicator has been used by Keasey et al. (2015) and Gupta et al. (2018).

In our estimations, we use one-year-forward values of the FDE indicators for two reasons: (i) enhancing the early-warning property of the hazard estimates; and (ii) reducing the risk of reverse causality between the FDE indicator and its predictors in the hazard model. Our preferred indicator is the one-year-forward value of FDE2, based on the predictive power of the baseline models estimated with three alternative FDEs. The estimation sample based on FDE2 consists of 13,986 publicly listed firms in 73 two-digit SIC industries (including finance) observed over 23 years (1992-2014). It excludes observations in the top and bottom percentiles of the total asset distribution as potential outliers. The annual distribution of the distressed and distress-free firms in the estimation sample is presented in *Table 1*.

Insert Table 1 here.

Over the estimation period, 11.66% of the firms experience one or more financial distress events. The percentage of financial distress events was above average around the *dot-com* bubble crisis (2000-2004) and during the global financial crisis (2007-2010). This pattern provides *prima facie* evidence that the informational content of our FDE indicator is pertinent as the financial distress risk is higher in the run up to and during downturns in the business cycle (Levy and Barniv, 1987).

The distribution of distressed and distress-free firms by country is reported in *Table A2* in the *Appendix*, where we observe that the percentage of financially distressed firms is the highest among two English-Law-Origin countries: The United Kingdom (13.13%) and United States (17.80%). These are followed by continental European countries such as France and Germany (around 6-7 %) and emerging markets (Brazil and Turkey) around 4-5 %. The lowest frequency of financially distressed firms (1.8%) is observed in Austria.

The main hazard predictors we consider are leverage and its square, product-market competition and its square, the interaction between leverage and competition, and duration (time to event) and its square. In the main text, we use $LEVERAGE_1$, defined as the ratio of total debt to total assets (*TDTA*) of firm *j* in industry *k* and year *t*. For robustness checks in the Appendix, we

use $LEVERAGE_2$ - defined as the ratio of total debt to the sum of total debt and common equity. We limit the maximum leverage ratio to 1, but we conduct sensitivity checks with higher ratios of up to 2.

We use two measures for product-market competition too. In the main text, we use a firm-level measure, $COMPETITION_1$, defined as one minus the Lerner index of firm *j* in industry *k* and year *t*. For robustness checks in the Appendix, we use an industry-level measure that is purged of firm-specific effects. Denoted as $COMPETITION_2$, it is defined as 1 minus the average Lerner index at the two-digit industry level. Either measure indicates absence of competition (full market power) if it is 0, perfect competition if it is 1, and imperfect competition in between. Finally, the Lerner index, *LERNER*, is defined as the ratio of profits before interest (*EBIT*) to net sales (NET_SALES_{kjt}), where *EBIT* is earnings before interest payments.[11] Formally:

(1a) $$COMPETITION\_1_{kjt} = 1 - (LERNER_{kjt})$$

(1b) $$COMPETITION\_2_{kt} = 1 - \left(\frac{\sum_{j=1}^{J} LERNER_{kjt}}{J}\right)$$

(1c) $$LERNER_{kjt} = \left(EBIT_{kjt} \Big/ NET\_SALES_{kjt}\right)$$

There is a long-standing debate on how to measure product-market competition (see, Boone, 2008; Elzinga and Mills, 2011). Concentration measures such as the Herfindahl-Hirschman index (HHI) or market share of the top *m* firms are popular measures used by competition policy authorities, but they lack theoretical underpinnings that relate concentration to market power; and require correct definition of the market in question. On the other hand, competition measures based on the Lerner index (the price-cost margin) are based on microeconomic theory but have been criticized for failing to distinguish between deviations of the price from the marginal cost due to price setting from the deviations that may be due to efficiency. Boone (2008) correct for the possible conflation of the two sources of deviation by developing a competition measure based on relative profit differences. However, the Boone index does not have a benchmark; whereas the Lerner index allows for identifying perfect competition, absolute monopoly, and some

[11] The Lerner index and product-market competition measures we use here are informed by Aghion et al. (2005).

intermediate levels of market power in between. Therefore, we prefer the product-market competition indicators above, which are based on the firm's profitability ratio.

DURATION is constructed to reflect the length of the episode that elapses until a firm experiences financial distress. For firms that experience a single financial distress event (FDE) over the time dimension of the data (1990-2014), duration begins with the first year in which the firm is observed and ends in the year before the firm becomes financially distressed. If the firm experiences more than one FDEs, we construct episode-specific durations: one for each episode that begins with a non-FDE status and lasts until the firm enters financial distress. We take account of the dependence between the firm-specific durations through multi-level hazard models, where duration dependence is modeled as firm-specific frailty (Steele, 2011).

Although the main interest in this paper is non-monotonic effects of leverage and competition on financial distress hazard, we verify the stability of the hazard estimates to the inclusion of market-based and accounting variables as well as industry/macro level indicators such as growth volatility, lending rates, and business cycles. Following Shumway (2001) and Bauer and Agarwal (2014), we control for two market-based performance indicators, relative to industry and country averages. *The relative book-to-market ratio* (*REL_BMR*) measures the firm's book-to-market ratio relative to the country/industry average in year *t*. The other market-based covariate, *REL_BETA*, measures the firm's stock price volatility relative to market volatility in each country. This measure is based on the firm's market beta reported in *Worldscope*.

The accounting-based variables also reflect common practice in the literature and include relative returns on assets (*REL_ROA*) and relative current ratio (*REL_CURR*), both of which are constructed relative to the country/industry average in year *t*. Whilst *REL_ROA* is a measure of profitability relative to the firm's assets, *REL_CURR* is a measure of liquidity that reflects the firm's ability to pay short-term obligations. We expect the accounting- and market-based indicators to improve the predictive power of the financial distress hazard model only marginally if product-market competition and leverage provide sufficient information about the severity of the agency conflicts.

Only few studies have investigated the impact of industry and macroeconomic factors on financial distress hazard (e.g., Koopman and Lucas, 2005). Industry and macroeconomic factors are usually overlooked on the grounds that firm performance indicators already reflect the changes in the industry and macroeconomic conditions. Yet, there is a rich literature that investigates the relationship between country- and industry-level predictors and corporate default risk (see, Carling

et al., 2007). Findings in this literature indicate that industry- and country-level variables are significant predictors of credit risk and/or corporate default risk. Hence, we control for four industry- and country-level predictors, including: (i) the volatility of firm growth by country, industry and year (*GROWTH_SD_IND*); (ii) the growth rates of real GDP by country and year (*GROWTH_GDP*); (iii) country- and year-specific lending rates to business (*BUS_LEND_RATE*); and (iv) a binary indicator that captures two crisis episodes: the bursting of the *dot.com* bubble from 2001-2002 and the global financial crisis from 2008-2010. The macroeconomic variables (*GROWTH_GDP* and *BUS_LEND_RATE*) are from the World Bank's Open Data site.[12] Further information about the variables is provided in *Table A1* in the *Appendix*.

Finally, we use two proxy measures for agency costs to verify the severity of the agency problem and whether it is correlated with financial distress risk. The first (*AGENCY_COST1*) is the ratio of operating expenses to net sales revenue. It measures the management's effectiveness in minimizing the firm's operating costs, which include excessive perquisite consumption and other agency costs such as administrative and overhead costs (Ang et al., 2000). The higher is the ratio, the *more severe* is the agency problem. The second measure (*AGENCY_COST2*) is the ratio of net sales to total assets, which measures the management's effectiveness in deploying the firm's assets to generate sales revenue (Ang et al., 2000; Garanina and Kaikova, 2016). The higher is the ratio, the *less severe* is the agency problem. We proceed to estimate the effects of leverage and competition on financial distress hazard only after we verify the presence of agency costs and the latter's correlation with the frequency of the financial distress events.

Our hazard modelling strategy builds on Shumway (2001), who demonstrates that dynamic hazard models that take account of duration (time to event) are more appropriate than discriminant analysis or static models of financial distress (see also, Chava and Jarrow, 2004; Campbell et al., 2008, Bauer and Agarwal, 2014; Gupta et al., 2018). We extend the dynamic hazard model by taking account of firm-specific frailty that may be due to duration dependence and/or unobserved firm characteristics; and by correcting for potential correlation between unobserved frailty and the firm-level regressors in the hazard model.

Unlike Gupta et al. (2018), who control for frailty as a multiplicative term, we model frailty as an additive random effect in a multi-level hazard model. This is in line with Steele (2011), who demonstrates that multi-level models (MLMs) can be used to take account of recurrent events by

[12] https://data.worldbank.org/, accessed several times in 2019.

nesting the event episodes within the firm instead of treating them as random realizations of independent events in the population. In a two-level hazard model, firm *j* can be either in a distress-free or financial distress *episode,* denoted by *i = 1* if the firm is in financial distress or *i = 2* if the firm is distress free. Furthermore, the firm can experience one or more financial distress events, leading to multiple episodes during the analysis time. Then the probability that a financial distress event occurs at time *t* and episode *i* can be stated as follows:

$$P_{tij} = \mathrm{P}\left(y_{tij} = 1 \,\middle|\, y_{t'ij} = 0 \quad for\ t' < t\right) \tag{2}$$

Here P_{tij} is the probability that a financial distress event (FDE) occurs. The observed outcome variable, y_{tij}, is a binary indicator that is 1 if the firm is in financial distress (i.e., if it satisfies the conditions for one of the financial distress events defined above); and 0 otherwise. The episode indicator *i = [1, 2]* indicates whether the firm is distress-free (1) or it is in a financial-distress episode (2).

If the firm is in a distress-free episode to start with (i.e., if *i = 1*), the observed outcome, y_{tij}, can be considered as a 'trial', where the probability of 'success' (the probability that the financial distress event occurs) is P_{tij} and the probability of 'failure' (no event) is $1 - P_{tij}$ (Steele, 2011). On the other hand, if the firm is in a financial-distress state to start with (i.e., if *i = 2*), P_{tij} is the probability that the firm recovers from financial distress.

We are interested in the probability of the firm lapsing into financial distress, taking into account the possibility that different firms may have different histories of financial distress events (*FDEs*) with different patterns of recurrence. To estimate the probability of financial distress among firms with different histories of recurring financial distress events, we propose a two-level hazard model where within-firm frailty is modeled as firm-specific intercepts (u_{0j}) and slopes (u_{1j}). In this two-level setup, the firm/year observations of the distress event indicator (level 1) are nested within the firm (level 2), which can also be nested within industries (level 3). Here, we focus on two-level hazard models, but we also test if three-level models are justified using likelihood ratio (LR) tests during estimations.

In a two-level setting, the probability of financial distress hazard (P_{tij}) with frailty at the firm level can be stated as a function of a baseline hazard [$\mathbf{D}_{tij}$ = 1 t t^2], a vector of firm-level explanatory variables ($\mathbf{X}_{tij}$), and two random-effect terms that capture intercept heterogeneity (u_{0j}) and slope heterogeneity (u_{1j}):

(3) $$g(P_{tij}) = \boldsymbol{\alpha}\mathbf{D}_{\text{tij}} + \boldsymbol{\beta}\mathbf{X}_{\text{tij}} + u_{0j} + u_{1j}$$

In (3), $g(.)$ is a link function that can be a *probit*, *logit* or complementary loglogistic (*cloglog*) link.[13] On the other hand, $\mathbf{D}_{tij}$ is the baseline hazard that is a quadratic function of the time-to-event (i.e., duration). Finally, shared frailty (u_{0j} *and* u_{1j}) captures unobserved firm characteristics that determine the firm's frailty - i.e., its proneness to experience financial distress and hence the dependence between the financial-distress events it experiences. In (3), frailty is modeled as firm-specific random intercepts and slopes, with the implication that the probability of financial distress is firm-specific with or without controlling for the predictors of financial distress in **X**. Combining Shumway (2001) with Steele (2011), the survival function of a multi-level hazard model with a *logit* link function can be stated as follows:

(4) $$S(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta}) = 1 - \sum_{\tau<t} f(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta}) = 1 - F(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta})$$

Conversely, the hazard function ($\mathcal{H}$) indicates the probability of failure (financial distress) given that the firm has survived until t and can be stated as follows:

(5) $$\mathcal{H}\left(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j,v_{1j}}; \boldsymbol{\beta}\right) = \frac{f(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta})}{S(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta})}$$

Assuming a logit link function as Shumway (2001) does, parameter estimates ($\boldsymbol{\beta}$) can be obtained by maximizing a multi-period likelihood function of the following form:

(6) $$\mathcal{L} = \prod_{j=1}^{N} \mathcal{H}\left(\left(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta}\right)\right)^{y_{tij}} \left[\prod_{\tau<t_{ij}} 1 - \mathcal{H}\left(\left(t_{ij}, \mathbf{X}_{\text{tij}}, u_{0j}, u_{1j}; \boldsymbol{\beta}\right)\right)\right]$$

The firm-specific hazard probability is due to frailty, which can be modelled either as firm-specific random intercepts (u_{0j}) or random slopes (u_{1j}) or both. Both random effects are assumed to be distributed normally with zero means and constant variances – that is, $u_{0j} \sim N(0, \sigma_0^2)$ and $u_{1j} \sim N(0, \sigma_1^2)$.

The multi-level hazard models for estimation are stated in (7.1) and (7.2) below. In (7.1), we state the parsimonious model informed by agency theory, where the quadratic terms for leverage and competition allow for non-monotonic effects on financial distress hazard and the interaction term allows for establishing whether the effects of the two incentive-alignment mechanisms are

[13] A probit link function can also be chosen if one assumes that the underlying distribution of the financial distress event is normal; or if it reflects a proportion of the population but not a binary outcome (Gupta et al., 2018). We do not use probit as a link function, but trials with a probit link function yield similar results. The latter are not reported here to save space, but they are available on request.

substitutes or complementary. The model is augmented with a quadratic specification for duration (the time to financial distress event), in line with the dynamic hazard model proposed by Shumway (2001). In (7.2), we state the model augmented with control variables, which consist of accounting- and market-based variables at the firm level and external economic environment variable at the industry and country levels. This augmentation allows for verifying if: (i) the sign and significance of the estimates from the parsimonious model remain robust to incorporation of control variables; and (ii) the incorporation of economic/financial predictors into the hazard model improves the predictive power of the model. In either model, we use the estimated coefficients for leverage and its square us to test for the first hypothesis (*H1*), those on competition and its square to test for *H2*, and the coefficient for the interaction term to test for *H3* – after taking account of duration and its square. In all estimations, we include a full set of year dummies ($\delta_{1t}\ or\ \delta_{2t}$) as recommended by Wooldridge (2010, p. 332). Finally, we use one-year-forward FDE indicators to reduce the risk of simultaneity and obtain early-warning information from the hazard model.

$$(7.1)\quad FDE_{t+1,j} = \beta_{10} + \beta_{11}LEVERAGE_{tj} + \beta_{12}LEVERAGE\_SQ_{tj} + \beta_{13}COMPETITION_{tj} + \beta_{14}COMPETITION\_SQ_{tj} + \beta_{15}(LEVERAGE \times COMPETITION)_{tj} + \beta_{16}DURATION_{tj} + \beta_{17}DURATION\_SQ_{tj} + \delta_{1t} + u_{1oj} + u_{11j} + \omega_{1tj}$$

$$(7.2)\quad FDE_{t+1,j} = \beta_{20} + \beta_{21}LEVERAGE_{tj} + \beta_{22}LEVERAGE\_SQ_{tj} + \beta_{23}COMPETITION_{tj} + \beta_{24}COMPETITION\_SQ_{tj} + \beta_{25}(LEVERAGE \times COMPETITION)_{tj} + \beta_{26}DURATION_{tj} + \beta_{27}DURATION\_SQ_{tj} + \sum_i \beta_{28i}\, MRKT\_PERF_{itj} + \sum_i \beta_{29i}\, ACCT\_PERF_{itj} + \sum_i \beta_{30i}\, IND\_MACRO_{it} + \delta_{2t} + u_{2oj} + u_{21j} + \omega_{2tj}$$

Here, *LEVERAGE*, $COMPETITION$ and *DURATION* are leverage, competition, and duration, respectively. *MRKT_PERF*, *ACCT_PERF* and *IND_MACRO* include the market, accounting, and industry/country covariates, as described above. The frailty terms are specified as firm-specific random intercepts ($u_{10j}\ or\ u_{20j}$) and slopes ($u_{11j}\ or\ u_{21j}$). Finally, ω_{1tj} and ω_{2tj} are the idiosyncratic error terms in (7.1) and (7.2) respectively.

We conduct likelihood ratio (LR) tests after each estimation to verify the correct specification of the frailty as a random-effect component. First, we establish whether inclusion of frailty as a random intercept is preferable to so-called fixed-effect-only (restricted) specifications. If the specification with frailty is preferred, we then test whether frailty should be modelled as

random-intercepts only or as random-intercepts and random-slope specification. The test results indicate that the inclusion of frailty (i.e., multi-level modelling) is preferable; and that frailty should be modelled study-specific random-intercepts at the firm level combined with study-specific random slopes for *LEVERAGE* within each firm. Finally, we compare the multi-level model estimations with alternative link functions (*logit*, *probit* and *complementary log logistic*) to verify the link function that yields better log-likelihood (LL) and information criteria values. These checks indicate that the multi-level model with a *logit* link ensures better fit than those with *probit* or *clog-log* links.

Furthermore, in the estimation of the hazard models, we take account of potential endogeneity that arise from: (i) correlation between frailty and financial distress predictors (type-1 endogeneity); and (ii) reverse causality between the financial distress event outcome and the latter's predictors (type-2 endogeneity). To take account of type-1 endogeneity, we follow Mundlak (1978) and test if frailty is correlated with the regressors. If correlation exists, we augment the hazard model with Mundlak (1978) corrections, which consist of within-firm averages of the financial distress predictors to ensure mean independence between frailty and the regressors (Wooldridge, 2010; Greene, 2011).[14]

To address type-2 endogeneity, we conduct robustness checks based on a two-step sequential estimation strategy, where we obtain predicted values of leverage and duration in the first step and then use these predicted values as regressors for the hazard model in step 2. The predicted values are obtained from the following least-square regressions.

$$LEV\_HAT_{ktj} = \alpha_{10} + \alpha_{11} LN\_TA_{ktj} + \alpha_{12} AV\_LEVERAGE\_IND_{kt} + \alpha_{13} GDP\_GRWTH_{ct} + \alpha_{14} CRISIS\_Dummy_t + \varepsilon_{1ktj} \quad (8.1)$$

$$DUR\_HAT_{ktj} = \alpha_{20} + \alpha_{21} LN\_TA_{ktj} + \alpha_{22} AV\_DURATION\_IND_{kj} + \alpha_{23} CRISIS\_Dummy_t + \varepsilon_{2ktj} \quad (8.2)$$

In (8.1) and (8.2), *k*, *t* and *j* denote industry, year, and firm, respectively. On the other hand, *c* denotes country. The predicted leverage (*LEV_HAT*) is estimated as a function of firm size (measured with the logarithm of total assets, *LN_TA*); the average level of leverage in the firm's industry in year *t* (*AV_LEVERAGE_IND*); GDP growth in the firm's country in year *t* (*GDP_GRWTH*); and two sets of crisis dummies defined in *Table A1* in the *Appendix*. The predicted duration is estimated as a function of firm size as defined above; the average duration in

[14] Although Mundlak corrections require within-firm averages in the population, simulation studies report that estimates based on within-firm averages in the sample yield unbiased estimates (Grilli and Rampichini, 2011).

the firm's industry in year t (*AV_DURATION_IND*); and two sets of crisis dummies defined in *Table A1* in the *Appendix*. We do not obtain predicted competition because the latter is not correlated in a post-estimation test where we regressed the observed competition on the error term of the hazard model. We acknowledge that this two-step (sequential) approach is less efficient than simultaneous estimation, but we remain confident about its validity on the ground that neither predicted leverage nor predicted duration are correlated with the error term of the of the estimated hazard model. Overall, our findings from the sequential estimation remain consistent with those obtained from the original models specified in (7.1). and (7.2) above.

Therefore, we are confident that the coefficient estimates we obtain from (7.1). and (7.2) are consistent. Given that they are informed by the agency theory, we can also argue that they can be interpreted as causal effect sizes as they are purged of the confounding effects of frailty through Mundlak (1978) corrections and that reverse causality is not a significant confounder in our sample. Under the null hypotheses H_1, H_2 and H_3, the expected signs for the coefficients in the parsimonious model (7.1) are summarised in *Table 2* below.

Insert Table 2 here

We also conduct U-tests to verify if the turning points for the hazard effects are significant and occur within the data range in the sample. For this, we draw on Lind and Mehlum (2010), who identify the necessary and sufficient conditions for the validity of the extremum points in quadratic models. The procedure not only tests for correct sign of the linear and quadratic terms, it also calculates a Fieller interval for the extremum point to verify if the interval lies within the data range.

To verify the robustness of the hazard estimates to different FDE definitions, we estimated the baseline model with three different FDE indicators and chose the indicator that yields the best diagnostic values in terms of log-likelihood (LL) statistic, area under the receiver operating characteristic curve (AUC). The results indicate that the *one-year-forward financial distress event 2* ($FDE2_{t+1}$) is preferable. The second set of sensitivity checks involves stepwise estimations, where we augment the baseline model with accounting, market, and industry/macro-level covariates. The results indicate that the hypothesized non-monotonic and substitution effects remain robust, and the predictive capacity of the augmented models is only marginally better than

the parsimonious model. As a third set of sensitivity checks, we have estimated the baseline model with different firm cohorts, using samples of non-financial and non-utility firms, firms in countries with English Law origin, US and non-US firms, and samples that include highly leveraged firms with leverage ratios greater than 1. The results indicate that the non-monotonic effects of competition and the effects of leverage and competition as substitute discipline devices remain robust in all samples, but the non-monotonic effect of leverage disappears when the level of leverage is greater than 1.

5. Results

We first report descriptive evidence indicating that firms in our estimation sample are faced with different levels of agency costs; and that the frequency of financially distressed firms is positively correlated with the severity of the agency problem (*Table 3*). The descriptive evidence indicates that higher values of *managerial slack* (measured with *AGENCY_COST1*) are associated with a higher frequency of the financial distress events. In contrast, higher values of *managerial effort* (measured with *AGENCY_COST2*) are associated with a lower frequency of the financial distress events. Evidence in *Table 3* indicates that: (i) agency costs are present in the sample; (ii) firms are heterogenous with respect to the levels of managerial slack/effort they face (variances of 2.537 for *AGENCY_COST1* and 0.535 for *AGENCY_COST2*); and (iii) managerial slack (managerial effort) is associated with higher (lower) probability of financial distress. Hence, there is *prima-facie* evidence in favour of controlling for non-linear and substitution effects of leverage and competition on financial distress risk - in accordance with insights from the agency theory.

Insert Table 3 here

We now turn to the effects of leverage and competition on financial distress hazard reported in *Table 4*. The results in Table 4 take account of type-1 endogeneity (i.e., the correlation between frailty and the regressors) through Mundlak (1978) corrections for all the regressors. The model based on one-year-forward *FDE2* indicator is preferred in terms of predictive power. The area under the receiver operating characteristics curve (AUC) is 94.4% when prediction is based on full information from the multi-level model; and 87.1% when prediction is based on fixed-effect components only. The full-information AUC value from our *baseline model* is better than 95% of

the AUC values in Gupta et al. (2018), who estimate 54 hazard models using 13 market- and accounting-based variables. Furthermore, both the full-information and fixed-effect-only AUC statistics for our baseline model are higher than those reported in Bauer and Agarwal (2014), whose models also include market- and accounting-based regressors.[15]

Insert Table 4 here

Continuing with the bottom half of *Table 4*, we observe that the baseline hazard rate (captured by the 'average' estimate for the constant term) is firm specific. This is because the variance of the firm-specific intercepts (i.e., the variance of u_{10j} in model 7.1) is 0.886 for *FDE1*, 3.507 for *FDE2* and 2.445 for *FDE3* – and statistically significant. Secondly, the likelihood ratio (LR) tests indicate that the multi-level model with random intercepts for the baseline hazard and random slopes for leverage is preferable to restricted alternatives that overlook between- and within-firm heterogeneity. Finally, the intra-firm correlation of the financial distress event observations is positive (around 0.5) and highly significant. This finding indicates that firms tend to have *sui generis* financial distress histories, which require the use of a multi-level modeling framework that takes account of within-firm correlation of financial distress events as shared frailty.

Returning to coefficient estimates in the top half of *Table 4*, we observe that the results lend support to hypotheses $\boldsymbol{H_1}$, $\boldsymbol{H_2}$ and $\boldsymbol{H_3}$. The results indicate that the effect of leverage on financial distress hazard is inverted-U-shaped; and that of competition is U-shaped. Furthermore, the negative coefficient on the interaction effect indicates that leverage and competition have substitutable effects on financial distress hazard. These findings are confirmed when we obtain the average marginal effects (AMEs) of the predictors on the financial distress probability, using the preferred *FDE2* indicator (*Table 5*). The AMEs are obtained as elasticities to indicate the percentage change in the probability of financial distress in response to a one-percent change in the covariates.

Insert Table 5 here

[15] The AUC values reported in Gupta et al. (2018) are 54 in total; and only 3 models yield AUC values ranging between 94% and 97%. The remaining 51 AUC values range between 76% and 92%. The AUC values reported in. Bauer and Agarwal (2014) range between 59% and 90%.

Our findings in *Tables 4 and 5* are in line with agency-theoretic predictions about the effects of leverage on financial distress risk. On the one hand, *the hazard-increasing* effect of leverage is observed when the initial level of leverage is low, the firm is in a 'shirking' regime, and the disciplining effect on managerial effort is weak. On the other hand, the *hazard-reducing* effect is observed when the initial level of leverage is high, the firm is in a 'bonding' regime, and the disciplining effect dominates the agency-cost effect. These results are consistent with Aghion et al. (1999a; 1999b), where leverage *does not* mitigate the agency problem if it increases from a low initial level but *does* mitigate the agency problem if it increases from a high initial level.

In the case of competition, the hazard rate decreases with competition when the latter increases from a low initial level, where the returns to cost reduction through increased managerial effort are high. In contrast, the hazard rate increases with competition when the latter increases from a high initial level, where the profit-diluting effects of competition are stronger and the manager's returns from cost reduction (i.e., from higher effort) are low.

The negative and significant coefficient on the interaction term (*LEVERAGE* ×*COMPETITION*) indicates that leverage and competition are substitute disciplining devices and as such it is compatible with the existence of agency costs reported in *Table 3* above. This finding lends support to $\mathbf{H_3}$ and is consistent with Aghion et al. (2002), where product-market competition and financial-market discipline are substitutes in the presence of agency problems among older firms in Central and Eastern European countries. Our findings indicate that an increase in leverage *reinforces (or prolongs)* the hazard-reducing effect of competition when the latter is kept constant. Similarly, an increase in competition *mitigates (or curtails)* the hazard-increasing effect of leverage when the latter is kept constant.

In *Figure 1*, we provide post-estimation evidence on the non-monotonic and substitutable effects of leverage and competition on financial distress hazard. The average marginal effects on the predicted mean hazard follows and inverted-U pattern in the case of leverage, and a U-shaped pattern in the case of competition. The average marginal effect of the interaction term, on the other hand, always falls as the product of leverage and competition increases (bottom left corner).

Insert Figure 1 here

Further post-estimation evidence is presented in and *Table 6*, which elucidates the substitution effects of leverage and competition. Using the preferred *FDE2* indicator and the baseline model in 7.1, we present tuning points for the curves that map the estimated effects of leverage and competition on financial distress hazard. The turning points for leverage are calculated by increasing competition by one decile at a time, whereas those for competition are calculated by creasing leverage by one decile at a time. The decile values for competition and the corresponding turning points for leverage are presented in columns 2 and 3; whereas the decile values for leverage and the turning points for competition are presented in column 4 and 5.

Insert Table 6 here

The evidence in columns 2 and 3 indicates that competition acts as a substitute discipline device that prolongs the hazard-reducing effect of leverage. This is evident from column 3, where the turning point for the effect of leverage on financial distress hazard occurs at lower levels of leverage as competition increases. Recalling that the effect of leverage on financial distress hazard is inverted-U-shaped, the lower levels of leverage at which the turning point occurs indicates that the *hazard-reducing* effect of leverage kicks in (i.e., the downward-sloping segment of the concave curve begins) at lower levels of leverage as competition increases. This is because the increase competition acts as a substitute disciplining device, which moves the firm in to a 'bonding regime', induces the manager to exert higher effort, and reduces the financial distress risk at lower levels of leverage compared to a scenario where competition remains constant. Stated differently, the firms would remain in a 'shirking regime' for longer and the hazard-increasing effect of leverage would dominate for longer in the absence of an increase in competition. Hence, in more competitive markets, a lower level of leverage is sufficient to move the firm into a 'bonding regime' where financial distress risk falls with leverage.

The evidence in columns 4 and 5 indicates a leverage substitution effect too. This is evident in column 5, where the turning point for the effect of competition occurs at higher levels of competition as leverage increases. Recalling that the effect of competition on financial distress hazard is U-shaped, the higher levels of competition at which the turning point occurs indicates that the *hazard-increasing* effect of competition kicks in (i.e., the upward-sloping segment of the

convex curve begins) at higher levels of competition as leverage increases. This is because the increase in leverage acts as a substitute disciplining device that reduces the scope for managerial slack particularly at low levels of competition, where the firm enjoys market power and the manager is able to lead a 'quite life'. Hence, we re-establish that firms in less competitive industries are better able to reduce the financial distress risk when their capital structure is characterised by more reliance on debt financing (i.e., less reliance on equity financing).

Stepwise estimation results reported in *Table 7* confirm that the non-monotonic and substitution effects of leverage and competition on financial distress hazard remain stable to augmenting the baseline model with market, accounting, and industry/country variables.[16] Moreover, the predictive power of the model as measured by AUC increases only marginally (from 94.4% to 94.9%) when it is augmented with accounting and market variables in columns 2 and 3 respectively. This is to be expected because both distress risk and firm performance in general are essentially managerial effort problems. Once we control for managerial effort through leverage and competition as disciplining devices, market and accounting indicators add only little new information as they are likely to be just symptoms of the underlying agency conflicts mitigated by leverage and competition. A slightly better improvement in the predictive power (from 94.9% to 96.7%) is obtained when industry and macroeconomic variables and a crisis indicator are added (column 4). This is also to be expected because the latter set of predictors are determined at the industry and/or country levels. As such, they are less likely to be symptoms of the underlying agency conflicts at the firm level.

Insert Table 7 here

Following Platt and Platt (2006), we use accounting/market variables relative to the industry to take account of industry effects. We find that the ratio of current assets to current liabilities relative to industry average (*REL_CURR*) is associated with an increase in financial distress hazard. This finding indicates that firms with larger current ratios relative to the industry average are less efficient in deploying their assets. In contrast, a larger return on assets ratios relative to industry average (*REL_ROA*) is associated with lower hazard rates. This is also to be expected because a higher ROA relative to the industry average reflects, among other things, higher

[16] Results in Table 6 are based on the preferred financial distress indicator, *FDE2*. We have estimated the augmented models with other FDE indicators too and obtained consistent results. The latter are not reported here to save space but can be provided on request.

managerial effort. Of the market variables, only the book-to-market ratio relative industry average (*REL_BMR*) is significant and associated with an increase in financial distress hazard. According to Campbell et al. (2008), the book-to-market ratio should be considered as a correction factor that reflects the extent of misalignment between market and the firm's own valuation of its value. From this perspective, our finding indicates that the firms in our sample tend to overestimate their book values compared to valuations by the market, which takes account of both current and future earnings and losses.

The final set of covariates in the augmented model relate to industry and macroeconomic variables, which tend to be under-investigated in the existing financial distress literature. We find that only the volatility of net sales growth in the industry (*GROWTH_SD_IND*) is significant and associated with an increase in financial distress hazard.

Our findings in Tables 4 – 7 warrant four conclusions. First, the effects of leverage and competition on financial distress risk are non-monotonic. Whereas the effect of leverage is inverted-U-shaped, that of competition is U-shaped. Secondly, leverage and competition are substitute incentive alignment devices in that the firm can mitigate the agency problem and reduce the financial distress risk by adjusting one or the other device. Third, information about leverage and competition is sufficient to specify a hazard model with a high level of within-sample predictive power, which is comparable to and even better than within-sample predictive powers reported in the literature. With respect to business decision making, our findings imply that the firm's optimal capital structure that minimizes financial distress hazard depends not only on the firm-specific factors usually controlled for in the empirical models of capital structure (see, for example, Öztekin, 2015) but also on product-market competition. This is because the optimal level of debt financing that minimizes financial distress risk of firms in less competitive industries is higher than those firms in more competitive markets.

We have conducted several robustness checks to verify if our findings are robust to different firm cohorts, leverage and competition measures, and control for reverse causality. *Table A4* in the Appendix reports the results based on five different firm cohorts: (i) firms excluding the financial sector; (ii) firms excluding the financial, transport and utility sectors; (iii) US-listed firms only; (iv) non-US firms; and (v) firms listed in countries with English Law origin. The results indicate that the non-monotonic effects of competition are robust across all firm cohorts, but the non-monotonic effects of leverage and the substitution effect are robust only in three out of five sub-samples (non-financials, firms excluding financials and utilities, and non-US firms). In the

remaining two sub-samples, the coefficients have the expected signs but remain statistically significant.

In *Table A5* (columns 1 and 2), we report estimates from the baseline model with higher cut-off points for the leverage ratio (the total debt / total assets ratio) at 1.5 and 1.75. The non-monotonic effects of competition and the substitute discipline effects are robust with both cut-off points. The coefficient estimates for leverage enter with correct signs, but only the quadratic term is significant. In column 3, we report estimates based on leverage defined as the ratio of total debt to the sum of total debt and common equity. In column 4, we use an industry-level competition measure. It is calculated as 1 minus the average industry-level Lerner index by country and year. All coefficient estimates are significant and have the predicted signs.

In *Table A6*, we report estimation results based on predicted values of the regressors, as specified in models (8.1) and (8.2) in the methodology section. Before estimation, we checked if leverage, competition, and duration are correlated with the error term of the hazard model estimated with observed values of these regressors. Whilst leverage and duration are found to be correlated with the conditional (post-estimation) error term, competition was not. Hence, we obtained predicted values for the potentially endogenous predictors in the first step of the sequential estimation and used the predicted values as regressors in the hazard models based on three FDE indicators. The signs and significance of the coefficient estimates for leverage and competition remain consistent after taking account of potential endogeneity due to reverse causality. However, the coefficient estimates for the interaction term (*LEVRAGE×COMPETITION*) are significant only in 1 out 3 robustness checks. We interpret the findings as evidence that endogeneity due to reverse causality is a minor problem in our sample. Even after taking account of type-2 endogeneity, the evidence lends consistent support to ***H1*** and ***H2***, and partial support to ***H3***.

Finally, we have checked whether short-term or long-term debt is a stronger incentive alignment mechanism. One check consisted of estimating the hazard model with long- and short-term debt components separately. Whilst the non-monotonic and substitute effects of leverage based on long-term debt are significant, the effects of leverage based on short-term debt are not.[17] The other check consisted of regressing the predicted financial distress probability and the

[17] Short-term debt consists of interest-bearing obligations with a maturity period of one year or less plus the current portion of the long-term debt due within a year. Long-term debt has a maturity period of more than one year(s). We do not report these estimation results here to save space, but they are available on request.

managerial slack (measured as the ratio of operating expenditures to net sales - *OPEX/SALES*) on two types of debt: long-term debt with a maturity period of over one year; and short-term debt with a maturity period of less than a year. The results in panel A of *Table A7* in the Appendix indicate that short-term debt increases whereas long-term debt reduces the predicted probability of financial distress. The results in Panel B, on the other hand, indicate that short-term debt increases or has no effect on managerial slack whereas long-term debt reduces managerial slack in each specification. Our findings suggest that the discipline effect of leverage is stronger among firms with higher levels of long-term debt.

Our findings on the effects of short- and long-term debt contributes to the research effort on whether short- or long-term debt is more effective in mitigating agency conflicts and reducing financial distress risk. In conventional corporate finance theory, the cost of agency conflicts can be mitigated by using short-term debt. This is because short-term debt involves frequent rollovers and thus disciplines managers (Jensen and Meckling, 1976; Leland and Toft, 1996); or because the fragility induced by short-term debt prevents managerial moral hazard (Calomiris and Kahn, 1991). The theoretical work in this tradition has informed a rich empirical literature that often reports supportive findings (see, for example, Ben-Nasr et al., 2015; Belkhir *et al*., 2016; Huang et al., 2018; Boubaker *et al*., 2019).

Nevertheless, such findings have been contested in several and particularly more recent studies. For example, Graham and Harvey (2001) survey firm managers and fail to find evidence that short-term debt reduces the probability of undertaking risky projects. Later, Eisenbach (2017) report that the increased use of short-term debt prior to the global financial crisis of 2007–2009 went hand in hand with exceedingly risky activities. Similar findings have been reported by Custódio et al. (2013) who demonstrate that the shortening of debt maturity has increased the exposure of US firms to credit and liquidity shocks; and by Diamond and He (2014) who report that the investment incentives is lower among firms with higher levels of short-term debt. More recently, Chen and Duchin (2019) find that firms that rely more on short-term debt tend to increase the riskiness of their assets when they are close to financial distress.

These findings suggest that the expected monitoring effect of the short-term debt may be overstated. Part of the reason is that the literature tends to assume frictionless financing and does not take account of debt pricing. The implications of such oversight have been discussed in a recent theoretical paper by Della Seta et al. (2020), where the authors demonstrate that in a world of refinancing frictions and fair debt pricing short-term debt indeed increases incentives for risk-

taking. Our findings tie in with and contribute to the emerging empirical and theoretical work, which draws attention to the ineffectiveness of short-term debt in disciplining managers and reducing financial distress risk.[18]

In conclusion, our findings suggest that the firm can adjust its capital structure to minimise the risk of financial distress at each level of product-market competition. Nevertheless, it must be stated that the firm's leverage decisions also depend on other determinants of capital structure such as firm size, tangibility, profitability and industry leverage (Öztekin, 2015); and other factors such as debt source, debt maturity and cost of debt (Huang and Shang, 2019). Therefore, our finding that calls for higher levels of debt financing in less competitive industries should be interpreted in conjunction with other determinants of debt financing decisions. It must also be recalled that higher levels of debt financing in less competitive markets is relevant when agency conflicts exist, and the firm's objective is to minimise financial distress risk by mitigating the agency costs.

6. Conclusions

In this paper, we have hypothesized that, in the presence of agency conflicts, leverage and product-market competition act as substitute disciplining devices with non-monotonic effects on financial distress hazard. Our hypotheses are informed by agency-theoretic work on debt accumulation and product-market competition, which analyse the role of leverage and competition in mitigating the agency problem and reducing the risk of financial distress.

Drawing on a sample of 13,986 listed firms observed from 1992 – 2014 and utilising a multi-level hazard model with shared frailty, we have reported two novel findings. First, leverage and product-market competition have non-monotonic effects on financial distress hazards. To be specific, the effect of leverage is inverted-U-shaped whereas that of competition is U-shaped. Secondly, we find that leverage and competition are substitute disciplining devices in that an increase in leverage (competition), *ceteris paribus*, reinforces the hazard-reducing effect of competition (leverage). These findings indicate that monotonic specifications for leverage and competition and lack of control for interactive effects between the two are potential sources of model misspecification bias in financial distress models. The causal mechanism that drives the

[18] Beyond the relative effectiveness of short- and long-term debt, there is also the issue of relative effectiveness of the bank debt *versus* bond debt. It would be good practice to control for the source of debt given the findings indicating that bank debt is associated with stronger monitoring and thus stronger effects on managerial effort (Boubaker et al., 2017 and 2018; Ben-Nasr et al., 2021). However, we are unable to address this question here as our data-source does not provide information on the source of debt.

non-monotonic effects on financial distress hazard is the *change* in the balance between the *discipline* and *agency-cost* effects of leverage and competition, depending at the initial levels of these substitute incentive-alignment devices.

We have also argued in favour of a multi-level hazard model that takes account of: (i) shared frailty that reflects within-firm dependence between financial distress episodes; and (ii) potential endogeneity that arises from correlation between unobserved frailty and predictors of financial distress hazard. We have taken account of endogeneity by augmenting the hazard model with Mundlak corrections, which consist of within-firm averages of the regressors. The multi-level hazard model yields better log-likelihood values and have higher predictive power than restricted equivalents such as pooled or random-effect logit. The findings from the multi-level hazard model remain highly robust to different financial distress event definitions and to augmenting the baseline hazard model with accounting, market, and industry/macroeconomic variables. The non-monotonic effects of leverage, however, are only moderately robust to variations in the sample. Particularly, we find that the linear leverage term is insignificant in samples consisting of US firms only, firms listed in countries with English Law origin, and in samples including highly leveraged firms. A common characteristic of the samples where the non-monotonic effect of leverage fails to hold is higher skewness of the leverage.

Our work contributes to existing knowledge in six areas. First, it draws on agency-theoretic work to develop a theoretical framework that allows for causal inference from financial distress modeling. The causal link between leverage or competition and financial distress risk is the *balance* between the *discipline* and *agency-cost* effects of leverage and competition on managerial incentives and effort. When the discipline effect dominates, financial distress hazard falls with leverage or competition; otherwise, it increases. Our second contribution is to show that both leverage and competition have non-monotonic effects on financial distress hazard. This contrasts with the current financial distress modeling effort, where leverage or competition are modeled with monotonic effects and never together. The non-monotonic effect is due to the *change in the balance* between the discipline and agency-cost effects. Here, we have demonstrated theoretically and empirically that the discipline effect dominates the agency-cost effect at low levels of competition but at high levels of leverage. Hence, the effect of competition on financial distress is U-shaped whereas that leverage is inverted-U-shaped. Our third contribution is that leverage and competition are substitute discipline (incentive-alignment) mechanisms in the presence of agency conflicts. The implication here is that either leverage or competition can be deployed as a substitute

incentive-alignment device when one of the devices is too low or given externally. Fourth, we demonstrate that the twin-issues of frailty and two types of potential endogeneity can and should be addressed in financial distress modeling to ensure that the estimates are not biased. Finally, we demonstrate that the accounting- and/or market-based predictors widely used in current empirical models explain only a small fraction of the financial distress risk after controlling for quadratic and interactive leverage and competition effects.

With respect to firm decision making, one implication from our findings is that the optimal level of leverage that minimizes the financial distress risk depends on the level of product-market competition. Specifically, the optimal level of leverage is higher (lower) among firms in less (more) competitive industries. Secondly, the discipline effect of leverage is due to long-term debt with a maturity period of more than one year(s) rather than short-term debt. Indeed, an increase in short-term debt ratio to total assets is associated with an increase in predicted financial distress probability and does not reduce the level of managerial slack.

Tables

The Tables below belong to manuscript titled:

Leverage, Competition and Financial Distress Hazard:

Implications for Capital Structure in the Presence of Agency Costs

Submitted for review to *Economic Modelling*

All tables are cited in the manuscript; and numbered consecutively.

Table 1: Distribution of Distressed and Distress-Free Firms by Year

Year	Total observations in year	Not Financially Distressed	Financially Distressed	Percentage of Financially Distressed
1992	1390	1331	59	4.24 %
1993	1508	1448	60	3.98 %
1994	1623	1571	52	3.20 %
1995	1781	1740	41	2.30 %
1996	2261	2161	100	4.42 %
1997	2702	2568	134	4.96 %
1998	3008	2812	196	6.52 %
1999	3395	3076	319	9.40 %
2000	4032	3528	504	12.50 %
2001	4520	3862	658	14.56 %
2002	4806	4050	756	15.73 %
2003	5147	4348	799	15.52 %
2004	5487	4771	716	13.05 %
2005	5840	5117	723	12.38 %
2006	6327	5583	744	11.76 %
2007	6660	5854	806	12.10 %
2008	7955	6984	971	12.21 %
2009	8257	7106	1151	13.94 %
2010	8518	7463	1055	12.39 %
2011	8859	7849	1010	11.40 %
2012	9250	8155	1095	11.84 %
2013	9704	8568	1136	11.71 %
2014	10897	9535	1362	12.50 %
Total	123927	109480	14447	11.66%

Notes: Based on the estimation sample estimated with the preferred financial distress event indicator, *FDE2*. *FDE2 = 1* if EBITDA is less than interest payment, EBIT is negative and Net Income is negative for 2 consecutive years; and *0 otherwise*. FDE2 is preferred on the basis of area under the ROC curve statistic. Summary statistics for samples based on two other *FDE* indicators are not reported here to save space but can be provided on request.

Table 2: Financial-Distress-Related Hypotheses and Expected Coefficient Signs

Hypothesis	Expected coefficient sign
H1 – Nonmonotonic leverage effect (inverted-U)	$\beta_{11} > 0; \beta_{12} < 0$
H2 – Nonmonotonic competition effect (U-shaped)	$\beta_{13} < 0; \beta_{14} > 0$
H3 – Substitutability of leverage and competition	$\beta_{15} < 0$

Table 3: Frequency of Financial Distress Events by Deciles of Managerial Effort Proxies

Agency cost deciles	Mean *AGENCY_COST1* in decile	Frequency of financial distress events[#] (%)	Mean AGENCY_COST2 in decile	Frequency of financial distress events[#] (%)
1	0.649	1.9	0.102	34.1
2	0.817	1.6	0.318	17.2
3	0.870	1.6	0.504	12.1
4	0.902	1.9	0.668	9.2
5	0.926	2.0	0.825	7.8
6	0.948	3.0	0.985	6.5
7	0.969	4.3	1.162	5.9
8	0.998	9.2	1.386	6.8
9	1.102	26.2	1.735	7.1
10	1.492	65.0	1.948	1.0
Variance	2.537		0.535	

Notes: [#]The financial distress event indicator is FDE2 as defined in section 4 above. The agency problem is more severe as *AGENCY_COST1* (Operating expenses over net sales) increases; but it is less severe as *AGENCY_COST2* (net sales over total assets) increases. The patterns of association between the mean value of the agency cost in the decile and the frequency of financial distress events also holds for FDE1 and FDE3. The latter are not reported here to save space, but they are available on request.

Table 4: Non-Monotonic and Substitute Discipline Effects of Leverage and Competition: Baseline Results with Alternative Financial Distress Events (FDEs)

Dependent variable:	**FDE1$_{t+1}$**	**FDE2 $_{t+1}$**	**FDE3 $_{t+1}$**
LEVERAGE	3.049***	1.075*	11.24***
	(0.597)	(0.615)	(0.865)
LEVERAGE_SQ	-2.770***	-1.185***	-8.035***
	(0.466)	(0.398)	(0.632)
COMPETITION	-3.357***	-8.239***	-1.125*
	(0.552)	(0.546)	(0.661)
COMPETITION_SQ	3.752***	7.823***	1.662***
	(0.456)	(0.471)	(0.457)
LEVERAGE×COMPETITION	-2.039***	-1.091*	-1.643**
	(0.515)	(0.565)	(0.640)
DURATION	0.222***	0.230***	0.373***
	(0.013)	(0.014)	(0.017)
DURATION_SQ	0.0057***	0.0044***	0.0015
	(0.000)	(0.0009)	(0.0009)
CONSTANT	1.279***	3.037***	-1.676***
	(0.324)	(0.490)	(0.414)
Extremum point for leverage	*0.550****	*0.454**	*0.699****
Extremum point for competition	*0.447****	*0.527****	*0.338***
Between-firm variance of the random intercepts	*0.886**** *(0.932)*	*3.507**** *(0.177)*	*2.445**** *(0.261)*
Between-firm variance of the random slopes	*7.786**** *(0907)*	*11.835**** *(1.217)*	*9.783**** *(1.195)*
Firm/year observations	*140080*	*123927*	*155085*
Firms	*14554*	*13986*	*16088*
Log-likelihood: Multi-level model	*-21429.1*	*-24029.2*	*-17084.0*
LR test (chi^2): Restricted model is nested within multi-level model	*6195.2*	*6173.6*	*4236.9*
p>chi^2	*0*	*0*	*0*
Intra-firm correlation	*0.212*	*0.516*	*0.426*
AUC – Incl. random effects	*0. 857*	*0.944*	*0.901*
AUC – Fixed effects only	*0. 809*	*0.871*	*0.840*

Notes: The dependent variable is the one-year-forward financial distress event (FDE) indicator, as defined in section 4 above. Log likelihood values for the restricted model are from *a random-effect logit* link. The null hypothesis in the likelihood ratio (LR) test is that the restricted model is nested within the multi-level model, and this is rejected in all columns. Intra-firm correlation indicates the correlation of the financial distress episodes within the firm. All estimations include a full set of year dummies and Mundlak corrections, which are not reported here to save space. *DURATION* is time-to-event in years and is episode-specific. It is the number of years in a single episode that precedes a non-recurrent FDE or in each of the episodes that precede recurrent FDEs. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Average Marginal Effects as Elasticities: Margins Based on *FDE2*

	Elasticity	SE	Z	P>z	Confidence	interval
LEVERAGE	0.056	0.029	1.87	0.061	-0.003	0.115
LEVERAGE_SQ	-0.059	0.020	-2.98	0.003	-0.098	-0.020
COMPETITION	-0.409	0.028	-14.86	0.000	-0.464	-0.356
COMPETITION_SQ	0.389	0.024	16.24	0.000	0.342	0.436
LEVERAGE×COMPETITION	-0.054	0.028	-1.93	0.054	-0.109	0.001
DURATION	0.011	0.001	16.85	0.000	.010	0.013
DURATION_SQ	0.0002	0.0000	4.95	0.000	.0001	0.0003

Notes: The Average Marginal Effect (AME) indicates the percentage change in the hazard rate in response to 1% change in the covariate. For other notes, see Table 4. AMEs based on other FDE definitions are similar. They are not reported here but are available on request.

Table 6: Extremum Points for the Estimated Hazard Rate:

Post-Estimation Evidence on Substitute Disciplining Effect of Leverage and Competition

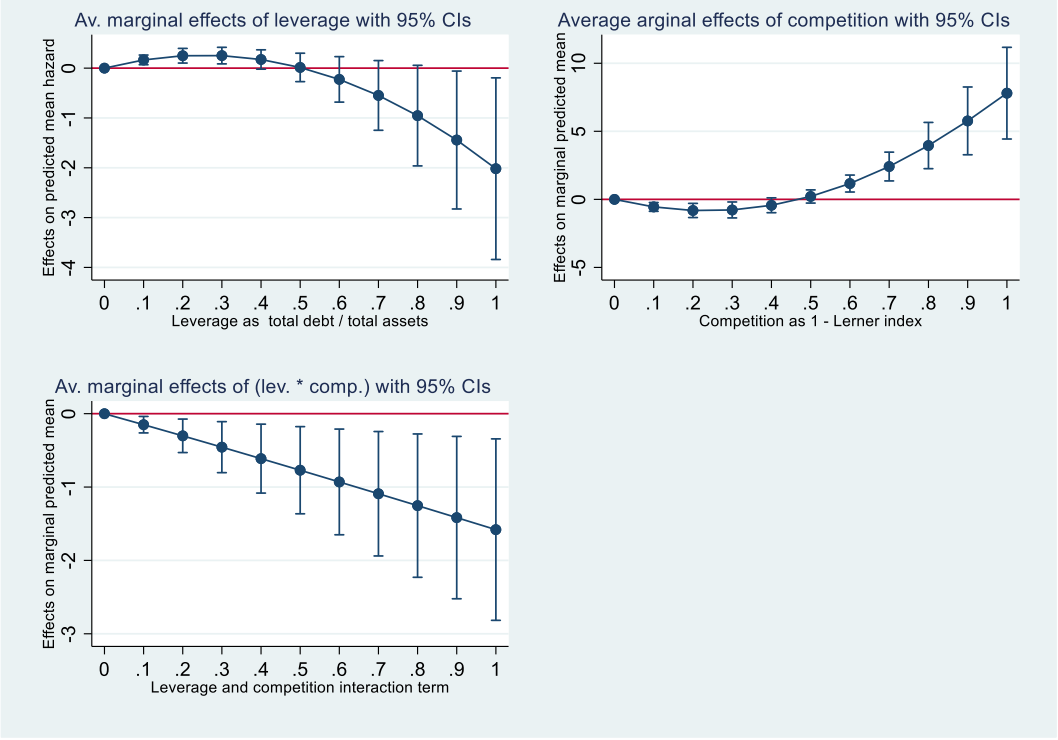
Decile	Competition at decile	Extremum point for leverage	Leverage at decile	Extremum point for competition
1	0.778	0.636	0.008	0.406
2	0.850	0.561	0.055	0.419
3	0.887	0.522	0.110	0.435
4	0.913	0.495	0.166	0.451
5	0.935	0.472	0.219	0.466
6	0.955	0.452	0.272	0.481
7	0.976	0.429	0.330	0.497
8	1.000	0.404	0.397	0.516
9	1.000	0.404	0.502	0.546

Table 7: Non-Monotonic and Substitute Discipline Effects of Leverage and Competition: Stability to Stepwise Estimations

	(1)	(2)	(3)	(4)
Dependent variable:	**$FDE2_{t+1}$**	**$FDE2_{t+1}$**	**$FDE2_{t+1}$**	**$FDE2_{t+1}$**
LEVERAGE	1.075*	3.372***	2.522***	2.619***
	(0.615)	(0.872)	(0.938)	(0.971)
LEVERAGE_SQ	-1.185***	-1.832***	-1.378***	-1.301***
	(0.398)	(0.421)	(0.490)	(0.487)
COMPETITION	-8.239***	-8.240***	-7.611***	-7.137***
	(0.546)	(0.684)	(0.745)	(0.728)
COMPETITION_SQ	7.823***	8.332***	7.657***	7.273***
	(0.471)	(0.547)	(0.595)	(0.592)
LEVERAGE×COMPETITION	-1.091*	-2.749***	-2.256**	-2.415**
	(0.565)	(0.849)	(0.905)	(0.943)
DURATION	0.230***	0.228***	0.202***	0.195***
	(0.014)	(0.0141)	(0.0153)	(0.0154)
DURATION_SQ	0.0044***	0.0037***	0.0049***	0.0053***
	(0.000)	(0.0009)	(0.0010)	(0.0010)
REL_CURR		0.0723***	0.0728***	0.0740***
		(0.0077)	(0.0086)	(0.0086)
REL_ROA		-0.0996***	-0.111***	-0.113***
		(0.0355)	(0.0405)	(0.0408)
REL_BMR			0.214***	0.223***
			(0.0277)	(0.0276)
REL_BETA			0.0796	0.0214
			(0.391)	(0.400)
GROWTH_SD_IND				0.664***
				(0.0634)
GROWTH_GDP				-0.235
				(0.277)
BUS_LEND_RATE				-0.644
				(0.521)
CRISIS_EPISODES				0.110
				(0.0772)
CONSTANT	3.037***	3.873***	4.166***	0.742
	(0.490)	(0.754)	(0.847)	(0.830)
Between-firm variance of the random intercepts	*3.507*** *(0.177)*	3.219*** (0.176)	3.024*** (0.188)	2.738*** (0.180)
Between-firm variance of the random slopes	*11.835*** *(1.217)*	11.606*** (1.222)	12.991*** (1.492)	12.376*** (1.464)
Firm/year observations	123927	116707	99604	96103
Firms	13986	13196	10962	10875
Log-likelihood	-24029.2	-22387.9	-18578.9	-18164.8
LR test (chi^2): Restricted model is nested within multi-level model	6173.6	6257.5	5470.4	5494.8
p> chi^2	0	0	0	0
Intra-firm correlation	0.516	0.495	0.479	0.454
AUC – Incl. random effects	0.944	0.946	0.949	0.967
AUC – Fixed effects only	0.871	0.882	0.890	0.921

Notes: The dependent variable is *preferred* one-year-forward financial distress event (FDE2) indicator, as defined in section 4 above. For details see Table 4. Column (1) is the baseline model; Column (2) is the baseline model augmented with market variables; Column (3) is the baseline model augmented with market and accounting variables; Column (4) is the baseline model augmented with market, accounting, and industry/macroeconomic variables. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1: Average marginal effects on predicted mean hazard



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Appendix

This is the *Appendix* to manuscript titled:

Leverage, Competition and Financial Distress Hazard:

Implications for Capital Structure in the Presence of Agency Costs

Submitted for review to *Economic Modelling*

All tables are cited in the manuscript; and numbered consecutively.

Table A1. Variable Definitions

Financial Distress	Financial distress is a binary variable that indicates whether the company is likely to fail in meeting its financial obligations to its creditors. It takes the value of 1 if the firm is under financial distress and 0 otherwise. We use five different financial distress indicators: • *FDE1* = 1 if the *interest coverage ratio* (EBIT/interest expense on debt) is less than 0.8 for 2 consecutive years and *market value growth* is negative for two consecutive years; and 0 otherwise. This FDE indicator is similar to Platt and Platt (2006), Pindado et al. (2008), Tinoco and Wilson (2013), Inekwe et al. (2018), and Fernández-Gámez et al. (2020) among others. • *FDE2* = 1 if EBITDA is less than interest payment, EBIT is negative and Net Income is negative for 2 consecutive years; and 0 otherwise. This indicator is similar to John, Lang, and Netter (1992), Pindado et al. (2008), Plat and Plat (2006), and Keasey et al. (2015). • *FDE3 = 1* if EBITDA is less than financial expenses, the net worth/total debt is less than one, and the net worth growth is negative for two consecutive years; and 0 otherwise. This indicator is similar to Keasey et al. (2015) and Gupta et al. (2018). In estimation, we use one-year-forward value of the financial distress indicator to obtain early warning information and avoid simultaneity. Our preferred financial distress event is FDE2, based on area under the ROC curve.
Hazard model variables:	
Main variables of interest:	
LEVERAGE 1 (TDTA)	Total debt / Total assets [= (Short Term Debt & Current Portion of Long Term Debt + Long Term Debt) / Total Assets].
LEVERAGE 2 (TDTC)	Total debt / (total debt + common equity).
LEVERAGE_SQ	Square of leverage measures.
COMPETITION	Product-market competition measured as 1 - firm Lerner index.
COMPETITION_SQ	Square of the competition measure.
LEVERAGE×COMPETITION	Interaction of leverage and competition measures.
Market-based covariates:	
REL_BMR	Firm's book-to-market, relative to industry and country average in year t.
REL_BETA	Measure of stock price volatility relative to market volatility. It is based on between 23 and 35 consecutive month-end price percent changes and their relativity to a local market index in year t.
Accounting-based covariates:	
REL_CURR	Ratio of current assets to current liabilities, relative to industry and country average in year t.
REL_ROA	Earnings before interest and taxes (EBIT) / Total assets, relative to industry and country average in year t.
Industry/Macro covariates:	
GROWTH_SD_IND	The standard deviation of sales growth in the industry.
GROWTH_GDP	Real GDP growth by country and year.
BUS_LEND_RATE	Business lending rate by country and year.
CRISIS_EPISODES	Dummy variable that is equal 1 if the year corresponds to Asian crisis or *Dot.com* bubble crisis (1998-2002) or global financial crisis (2007-2010); 0 otherwise.
DURATION	Years until financial distress occurs.
DURATION_SQ	Years until financial distress occurs – squared.
Agency cost variables:	
AGENCY_COST1	Ratio of operating expenses to net sales.
AGENCY_COST2	Ratio of net sales to total assets.
OPERATING_PROFIT_MARGIN	Ratio of operating income to net sales.
log(TOTAL_ASSETS)	Firms size measured with the logarithm of total assets

TANGIBILITY	Fixed-to-Total Asset ratio

Table A2. Distribution of Distressed and Distress-Free Firms by Country: 1992-2014

Country	Number of firms	Observation	Distress free	Financially distressed[#]	Percent
Austria	65	846	831	15	1.77%
Brazil	284	2542	2429	113	4.45%
France	571	6025	5686	339	5.63%
Germany	654	6497	6053	444	6.83%
India	2159	16380	15642	738	4.51%
Netherlands	110	1563	1517	46	2.94%
South Korea	1553	10846	10116	730	6.73%
South Africa	242	2211	2160	51	2.31%
Taiwan	1199	6475	6101	373	5.76%
Turkey	260	2478	2349	129	5.21%
United Kingdom	1274	13872	12051	1821	13.13%
United States	5615	54192	44544	9648	17.80%
Total	13986	123927	109479	14447	11.66%

Notes: [#]The financial distress event is FDE2, as defined in Table A1 above.

Table A3. Summary Statistics for Distressed and Distress-Free Firms in the Estimation Sample

	Distress-free Firm/year observations (109,480)				Distressed firm/year Observations (14,447)			
	Mean	**S.D.**	**Min.**	**Max.**	**Mean**	**S.D.**	**Min.**	**Max.**
Covariates in baseline model:								
LEVERAGE	0.246	0.201	0	1	0.211	0.240	0	1
LEVERAGE_SQ	0.101	0.137	0	1	0.102	0.178	0	1
COMPETITION	0.871	0.157	0	1	0.967	0.129	0	1
COMPETITION_SQ	0.783	0.210	0	1	0.951	0.156	0	1
LEVERAGE×COMPETITION	0.214	0.180	0	1	0.204	0.236	0	1
DURATION	7.070	5.497	0	23	5.046	3.830	0	23
DURATION_SQ	80.199	110.196	0	529	40.127	62.936	0	529
Accounting covariates:								
REL_CURR	-0.206	2.072	-14.827	29.206	0.375	4.127	-9.405	29.647
REL_ROA	0.097	0.312	-12.336	3.471	-0.297	1.083	-12.778	2.412
Market covariates:								
REL_BMR	0.0007	0.7535	-8.2212	5.9225	-0.0487	0.9981	-7.9276	5.7366
REL_BETA	1.063	0.413	0.002	4.128	0.889	0.431	0.002	3.100
Industry/Macro covariates:								
GROWTH_SD_IND	0.456	0.322	0.000	5.801	0.629	0.304	0.000	4.381
GROWTH_GDP	0.115	0.640	-0.713	28.946	0.087	0.543	-0.295	28.946
BUS_LEND_RATE	0.094	0.083	0.026	0.755	0.072	0.053	0.026	0.7
CRISIS_EPISODES	0.467	0.499	0	1	0.536	0.499	0	1

Notes: The variables are as defined in Table A1 above.

Table A4. Robustness Checks by Firm Cohorts

Dependent variable	$FDE2_{t+1}$	$FDE2_{t+1}$	$FDE2_{t+1}$	$FDE2_{t+1}$	$FDE2_{t+1}$
LEVERAGE	1.411**	1.652**	0.848	1.134*	-0.011
	(0.714)	(0.787)	(2.020)	(0.639)	(0.743)
LEVERAGE_SQ	-1.103***	-1.134***	-2.725*	-1.098***	-0.793*
	(0.410)	(0.432)	(1.480)	(0.415)	(0.420)
COMPETITION	-9.075***	-9.188***	-8.314***	-8.193***	-8.869***
	(0.581)	(0.620)	(1.467)	(0.585)	(0.623)
COMPETITION_SQ	8.569***	8.646***	7.969***	7.747***	8.207***
	(0.500)	(0.528)	(1.302)	(0.502)	(0.537)
LEVERAGE×COMPETITION	-1.508**	-1.720**	-0.718	-1.135*	-0.469
	(0.671)	(0.748)	(1.942)	(0.581)	(0.703)
DURATION	0.232***	0.227***	0.134***	0.246***	0.216***
	(0.0143)	(0.0146)	(0.0370)	(0.0151)	(0.0152)
DURATION_SQ	0.004***	0.004***	0.011***	0.003***	0.004***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
CONSTANT	4.770***	4.666***	3.732***	2.690***	3.058***
	(0.695)	(0.737)	(1.322)	(0.527)	(0.617)
Between-firm variance of	3.545***	3.582***	2.834***	3.617***	3.275***
the random intercepts	(0.182)	(0.190)	(0.433)	(0.193)	(0.184)
Between-firm variance of	12.188***	12.567***	21.248***	11.238***	10.850***
the random slopes	(1.274)	(1.342)	(6.313)	(1.222)	(1.299)
Firm/year observations	116586	106013	13872	110055	86655
Firms	12912	11874	1274	12712	9290
Log-likelihood	-22562.6	-21092.8	-2813.6	-21147.2	-18496.2
LR test (chi^2): Restricted model is nested within multi-level model	5937.6	5548.1	708.1	5516.0	4999.5
p>chi2	0	0	0	0	0
Intra-firm correlation	0.519	0.521	0.463	0.524	0.499

Notes: All results are estimated using multilevel mixed-effects logistic models with Mundlak corrections and a full set of year dummies. The Mundlak corrections and year dummies are not reported to save space. The variables are as defined in Table A1 above. Column (1) excludes firms in the financial sector; Column (2) excludes firms in the financial, utility, and transport sectors; Column (3) includes US firms only; Column (4) includes non-US firms only; Column (5) includes firms only in countries of English legal origin. Robust standard errors are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Robustness Checks with Different Leverage and Competition Specifications

Dependent variable: $FDE2_{t+1}$	Leverage (total debt/total assets) cut-off at 1.5	Leverage (total debt/total assets) cut-off at 1.75	Leverage as [total debt / (total debt + common equity)]	Competition defined as (1 – industry-level Lerner index)
LEVERAGE	0.579	0.733	0.967*	0.590*
	(0.516)	(0.485)	(0.573)	(0.347)
LEVERAGE_SQ	-0.393*	-0.321*	-1.192***	-1.632***
	(0.231)	(0.190)	(0.370)	(0.433)
COMPETITION (1 - Lerner index)	-8.231***	-8.242***	-8.470***	-11.11**
	(0.537)	(0.536)	(0.581)	(5.473)
COMPETITION_SQ	7.817***	7.861***	8.145***	8.544**
	(0.462)	(0.461)	(0.500)	(3.518)
LEVERAGE×COMPETITION	-0.988**	-1.189***	-0.872*	-1.291**
	(0.465)	(0.441)	(0.522)	(0.585)
DURATION	0.223***	0.221***	0.255***	0.283***
	(0.014)	(0.014)	(0.015)	(0.016)
DURATION_SQ	0.004***	0.004***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
CONSTANT	2.704***	2.707***	2.820***	-10.54***
	(0.480)	(0.480)	(0.493)	(2.746)
Between-firm variance of the random intercepts	3.349***	3.300***	9.286***	16.22***
	(0.164)	(0.161)	(0.955)	(1.624)
Between-firm variance of the random slopes	8.890***	7.623***	3.810***	7.785***
	(1.011)	(0.925)	(0.206)	(0.331)
Firm/year observations	125227	125568	117840	123927
Firms	14071	14092	13445	13986
Log-likelihood	-24622.6	-24795.7	-21226.0	-26322.8
LR test (chi^2): Restricted model is nested within multi-level model	6360.2	6364.1	5269.9	3454.5
p> chi^2	0	0	0	0
Intra-firm correlation	0.504***	0.501***	0.537***	0.703***

Notes: Dependent variable is FDE2, as defined in Table A1 above. All results are estimated using multilevel mixed-effects logistic models with Mundlak corrections and a full set of year dummies. The Mundlak corrections and year dummies are not reported to save space. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6. Robustness Checks Taking Account of Endogeneity

Dependent variables:	$FDE1_{t+1}$	$FDE2_{t+1}$	$FDE3_{t+1}$
LEVERAGE	4.803***	5.929***	21.04***
	(1.416)	(1.800)	(2.495)
LEVERAGE_SQ	-5.746***	-14.26***	-20.51***
	(1.737)	(3.035)	(3.013)
COMPETITION	-4.387***	-9.479***	-1.198
	(0.586)	(0.615)	(0.775)
COMPETITION_SQ	4.233***	9.090***	1.879***
	(0.453)	(0.477)	(0.461)
LEVERAGE×COMPETITION	0.736	-0.152	-3.221**
	(1.010)	(1.237)	(1.334)
DURATION	0.135***	-0.151***	0.128**
	(0.032)	(0.040)	(0.052)
DURATION_SQ	0.003	0.020***	0.003
	(0.002)	(0.003)	(0.003)
CONSTANT	1.040**	1.487*	-3.975***
	(0.458)	(0.813)	(0.668)
Between-firm variance of the random intercepts	1.297***	5.710***	8.581***
	(0.072)	(0.580)	(1.003)
Between-firm variance of the random coefficient	96.33***	86.54***	45.04***
	(23.45)	(12.30)	(9.132)
Between-firm correlated the random effect	-13.39***	-15.13***	-15.39***
	(1.047)	(2.507)	(3.047)
Firm/year observations	136700	120566	126246
Firms	14376	13670	13918
Log-likelihood	-22797.6	-24274.6	-18788.0
LR test (chi^2): Restricted model is nested within the multi-level model	3766.1	4530.1	691.5
p>chi2	0	0	0
Intra-firm correlation	0.283	0.634	0.723

Notes: Dependent variables are defined in Table A1 above. All results are estimated using multilevel mixed-effects logistic models with Mundlak corrections and a full set of year dummies. The Mundlak corrections and year dummies are not reported to save space. The reported leverage, leverage square, the interaction term, duration, and duration square coefficients are predicted values from first stage estimations. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Relative Effectiveness of Short- and Long-Term Debt

Panel A: Effect short and long-term debt on the predicted probability of financial distress

Dependent variable:	(1) *Predicted probability of financial distress*	(2) *Predicted probability of financial distress*	(3) *Predicted probability of financial distress*
Short-Term Debt Ratio	0.093***		0.078***
to Total Assets	(0.005)		(0.005)
Long-Term Debt Ratio		-0.172***	-0.168***
to Total Assets		(0.004)	(0.004)
Constant	0.101***	0.136***	0.129***
	(0.000)	(0.001)	(0.001)
Number of observations	123863	123863	123863

Panel B: Effect short- and long-term debt on managerial slack

Dependent variable:	(1) *Operating expenditures/net sales*	(2) *Operating expenditures/net sales*	(3) *Operating expenditures/net sales*
Short-Term Debt Ratio	-5.418		-6.320
to Total Assets	(4.104)		(4.112)
Long-Term Debt Ratio		-10.004***	-10.273***
to Total Assets		(0.000)	(0.000)
Constant	5.312***	6.395***	6.986***
	(0.000)	(0.000)	(0.000)
Number of observations	123863	123863	123863

Notes: In Panel A, the dependent variable is the predicted probability of financial distress hazard with FDE2 as financial distress event. In Panel B, the dependent variable is the ratio of operating expenses to net sales (OPEX/SALES). Both sets of results are based on OLS estimations. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.