

# Chapter 11 Duration and Asset Sales: Theory and Evidence<sup>1</sup>

Eric Powers and Sergey Tsyplakov  
University of South Carolina

October, 2023

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<sup>1</sup>The corresponding author's email is [sergey@moore.sc.edu](mailto:sergey@moore.sc.edu). Part of the computer code for the numerical algorithm was developed while Sergey Tsyplakov was a visiting scholar in the Global Investment Research division at Goldman Sachs in New York City.

## Abstract

We provide a continuous-time model of a financially distressed firm that can file for Chapter 11 bankruptcy with a pre-determined protection period. A key aspect of our model is that the firm can divest a portion of assets. These sales can occur prior to or during bankruptcy. Proceeds are used to reduce debt, which can enable the firm to avoid bankruptcy altogether, or to successfully emerge from bankruptcy and continue operations with reduced debt and lesser assets. Also, the firm can pre-commit to sell assets when declaring bankruptcy. Filing with the commitment reduces legal expenses and financial distress costs incurred during bankruptcy. The firm's decisions are affected by expected bankruptcy protection duration as well as prevailing prices for the firm's assets. A suboptimally long protection period exacerbates agency conflicts between debt and equity and may lead the firm to declare bankruptcy prematurely (at lesser distress) as well as forego the first-best outcome of asset sales outside bankruptcy. Furthermore, the firm may delay selling assets while in bankruptcy, resulting in more frequent liquidation. A suboptimally short protection period also produces inefficiencies. Overall, the model advocates for an intermediate length protection period that can reverse agency conflicts by inducing the firm to enter bankruptcy with a commitment to sell assets, resulting in lower deadweight costs and greater firm value. Analysis of bankruptcies over the last 40 years shows that average bankruptcy duration shortened. As a result, firms are declaring bankruptcy later (in deeper distress) and there has been an increase in pre-bankruptcy commitments to sell assets as well as actual sales in bankruptcy, supporting the model's predictions.

# 1 Introduction

In the past three decades, asset sales have become significantly more prevalent for companies trying to emerge from Chapter 11 bankruptcy protection. Carving out divisions, discrete units, or subsidiaries can be a valuable option, enabling a firm to emerge from bankruptcy leaner and with less debt. Figure 1 displays the fraction of firms that sold a substantial fraction of assets during bankruptcies observed between 1980 and 2022.<sup>2</sup> The figure also plots the percentage of bankruptcy filings where the firm indicated prior to filing an intention to sell assets during the bankruptcy. For both the intention to sell assets and actual sales, there is a clear increasing time trend. A closely related trend also observable from the figure is that the time spent in bankruptcy has declined over time.<sup>3,4</sup> Finally, distressed firms are waiting longer to enter Chapter 11 bankruptcy and are in deeper stages of financial distress when they file.<sup>5</sup>

We argue that these are interrelated trends, reflecting an evolution of the Chapter 11 bankruptcy process towards a more efficient mechanism that advocates for shorter bankruptcy protection.<sup>6</sup> A shorter, but non-trivial, protection period can mitigate agency conflicts between debt and equity, reduce distortions in the firm's decisions, and improve firm value. We provide a continuous time dynamic model of bankruptcy that offers a unified explanation for these trends, along with supporting empirical evidence.

The model describes a two-division firm that has several options to manage its asset composition and capital structure. If earnings decline by enough, then the firm can sell assets of one division, using proceeds to reduce debt. Alternatively, the firm can enter Chapter 7 liquidation, or file for Chapter 11 bankruptcy, which allows the firm to stay in protection for some pre-determined duration. In our model, asset sales are at the discretion of the firm at prevailing market prices.

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<sup>2</sup>These can either be Section 363 sales which occur independently of a reorganization plan, or sales that are part of the reorganization plan. Section 363 of the bankruptcy code permits assets to be sold free and clear of existing liens. A §363 sale is certified by the bankruptcy court and is not subject to the voting process that is required to certify a reorganization plan. Thus, §363 sales can be completed quickly. See Erens and Hall (2011) for a discussion of §363 sale requirements and the increased usage of these sales over time.

<sup>3</sup>Bharath, Panchapegesan and Werner (2007), Iverson (2018), Ayotte and Ellias (2022), and Muller (2022) discuss this trend.

<sup>4</sup>Figure 1 plots the median time spent in bankruptcy for free-fall filings each year. Chapter 11 filings can be classified as free-fall, pre-negotiated, or pre-packaged. With pre-packaged filings, a reorganization plan has been voted on and accepted by creditors prior to the filing. With pre-negotiated filings, a reorganization plan has been sketched out and discussed with creditors, but no formal voting has occurred prior to filing. With free-fall filings, no reorganization plan exists prior to the filing.

<sup>5</sup>See Adler, Capkun, and Weiss (2013).

<sup>6</sup>See Hart (2000) for a discussion of the efficiency of bankruptcy procedures.

Conversely, liquidation is the disorderly piecemeal disposition of assets at fire sale prices.<sup>7</sup> While Chapter 11 bankruptcy protection allows the firm to suspend interest payments, it is a costly alternative for the firm due to ensuing legal expenses and financial distress costs during bankruptcy. When the firm chooses to file for Chapter 11, it faces an additional decision of whether to commit to a plan to sell one division as part of its reorganization plan. This matches real-world practice of many firms pre-announcing a plan for asset sales prior to entering bankruptcy protection.<sup>8</sup> If the filing firm declares a commitment to sell assets, legal expenses and financial distress costs during bankruptcy are lower than when there is no commitment. This is because creditors and other stakeholders have greater certainty that a feasible reorganization plan will ensue. For firms that file for Chapter 11 without a commitment to sell assets, they adopt a “wait-and-see attitude” and either recover and emerge from bankruptcy due to improvement in earnings, or acquiesce and eventually sell a division and successfully reorganize, or diminish and piecemeal liquidate the firm.

Our model incorporates multiple decisions for the firm and generates a rich set of testable predictions. The maximum allowable duration of the bankruptcy, known as the “protection period”, is a key parameter that affects decisions. Its length is exogenously specified, e.g., by bankruptcy courts, and is known to the filing firm. The firm must emerge and complete their reorganization by the end of the protection period. Otherwise, it is liquidated. A critical value for the market price at which the firm can sell its division determines favorable and unfavorable market conditions. If market prices are above the critical value, conditions are favorable. This might occur during an M&A wave or industry growth.<sup>9</sup> The sale of the division will provide enough cash for the firm to restructure and either exit bankruptcy or avoid bankruptcy altogether. With high asset prices, firm value is maximized if the firm does exactly that, i.e. the firm foregoes bankruptcy and restructures its debt on its own after selling its division. However, a firm operating to maximize shareholder value may instead choose to file for bankruptcy prematurely. The incentive to file early before the firm is in deep financial distress increases with the length of the protection period due to the increased flexibility that the firm has during bankruptcy. The perverse incentives to forego sales of

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<sup>7</sup>Several papers compare value losses in liquidation and reorganization. See for example, Lopucki and Doherty (2007), or Antill (2022).

<sup>8</sup>See Asquith, Gertner, and Scharfstein (1994) for the importance of asset sales for avoiding bankruptcy and Hotchkiss (1993, 1995) plus Denis and Rodgers (2007) for the importance of asset sales for successfully reorganizing when in bankruptcy. Also see Pulvino (1998, 1999) for evidence on the prices received by distressed and by bankrupt firms for used assets.

<sup>9</sup>Maksimovic and Phillips (1998) show that industry conditions affect the reorganization outcome in Chapter 11. See also Hotchkiss and Mooradian (1998) and Gilson, Hotchkiss and Osborn (2016)

division assets but instead to file for bankruptcy are because the firm gambles for resurrection and this gamble is more valuable when the firm can stay in bankruptcy longer. This leads to reduced survival rates, especially when protection periods are suboptimally long. Along with incentives to file prematurely, a longer protection period further reduces the incentive to pre-commit to sell assets prior to filing. In addition, longer protection reduces the incentive to sell assets during bankruptcy by those firms that don't pre-commit. This increases the chance that the firm does not emerge from bankruptcy and both divisions are liquidated at fire-sale prices. Additionally, higher costs of bankruptcy and financial distress accrue when the firm stays in protection longer. Creditors are the ones that are primarily exposed to these increased deadweight costs. Incentives are distorted because sale proceeds must be used to reduce debt, and this disproportionately benefits creditors at the expense of shareholders. We call this distortion in incentives the "delayed-disinvestment" problem which is worse with longer protection periods. This is a "dark side" of the Chapter 11 protection.

When market prices for divisional assets are below the critical value, model predictions change and the model uncovers "a bright side" of Chapter 11 bankruptcy protection. Here, the model predicts a range of protection durations where a decision to declare bankruptcy with the commitment to sell division assets can be value-maximizing for both shareholders and creditors. Thus, optimally designed Chapter 11 protection can reverse the "delayed-disinvestment" problem. Importantly, this sweet spot occurs when protection periods are of intermediate length – not too short or too long. With a very short protection period, shareholders do not file, but instead abandon the firm and liquidate both divisions since proceeds from selling a division will be too low to reduce debt to the point where the firm is viable. With a very long protection period, shareholders file for Chapter 11 with no commitment to sell assets. While this is still optimal from the perspective of shareholders, firm value suffers even more than in liquidation due to the higher expected costs of bankruptcy and financial distress gradually accruing and a low chance of orderly asset sales. In the intermediate protection period sweet spot, shareholders are incentivized to file for Chapter 11 with a commitment to sell assets. With a commitment to sell division assets, less value is lost to bankruptcy and financial distress costs as there is certainty that the firm will sell assets in an orderly manner and may successfully reorganize. In addition, liquidation and the ensuing deadweight losses are less likely. Thus, firm value exhibits a hump-shape with respect to the protection period.

The decline in observed time spent in bankruptcy displayed in Figure 1 is consistent with courts coming to the realization that giving bankrupt firms a "long leash" has significant downsides due to worse incentives and enhanced agency costs, which is a general prediction of the model. To test other model predictions, we use the Florida-UCLA-LoPucki Bankruptcy Research Database (BRD) along with matching COMPUSTAT data in our regression analysis. Our empirical approach assumes that distressed firms form expectations about the duration of their protection period by looking at recent bankruptcies. Our proxy for expected protection period duration is a moving average (median) of observed length of Chapter 11 bankruptcies that concluded in the prior two-year rolling window nationally. That is, if in the prior two years, courts were more likely to have approved motions to extend the automatic stay and firms subsequently stayed in bankruptcy for longer, then a firm contemplating filing for bankruptcy may expect the same treatment. As such, the timing of bankruptcy filings, the decision of whether to pre-commit to asset sales, and subsequent decisions to sell assets should, in part, be driven by this expectation.<sup>10</sup> In this approach, we indirectly assume that the length of stay in bankruptcy protection is largely at the discretion of the bankruptcy courts, and to a lesser extent at the discretion of the bankrupt firm itself.<sup>11</sup>

In support of model predictions, we find strong evidence that with longer expected protection periods observed earlier in the sample period, firms file for Chapter 11 bankruptcy while in relatively better financial health.<sup>12</sup> Filing firms are also less likely to pre-announce an intention to sell assets during bankruptcy when expected protection periods are longer. While not a direct prediction of the model, we find that bankrupt firms are more likely to choose free-fall filings and are less likely to choose pre-negotiated and pre-packaged filings when expected protection periods are longer. This is consistent with the flexibility of free-fall filings being of greater value to firms when expected protection periods are longer. Additionally, we find that firms that choose to enter bankruptcy and announce an intention to sell assets are more financially distressed than those that do not make such an announcement. Again, this is consistent with firms placing greater value on operational

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<sup>10</sup>Results are similar when we use a court district (rather than national) calculation of prior bankruptcy duration.

<sup>11</sup>Several papers discuss shopping across court districts – see e.g. Lopucki and Whitford (1991), Pouraghdam and Storaci (2017), or Levitin (2022). Another literature thread explores assignment of judges or uses random assignment within the chosen court district as an instrument: see, e.g. Chang and Schoar (2013), Dobbie and Song (2015), Iverson (2016), Antill (2022), Iverson, Madsen, Wang, and Xu (2023), Huther and Kleiner (2022), and Seth (2022).

<sup>12</sup>Adler, Capkun, and Weiss (2013) argue that during their sample period of 1993-2004, management and equity holders increasingly expect a "hard landing" where their return from bankruptcy will be zero. Moreover, they document a clear time trend where pre-filing leverage, liquidity, and profitability of Chapter 11 filers is worse later in the sample period.

flexibility when expected protection periods are long. Finally, we find that the longer is the expected protection period, the more likely are bankrupt firms to be eventually liquidated, rather than being merged with or acquired by another firm, or emerging from bankruptcy as an independent firm.<sup>13</sup>

A potential criticism in our theoretical and empirical approach may be that the length of stay in bankruptcy is not exogenously determined, but endogenously chosen by bankrupt firms. However, we stress that shorter observed bankruptcy duration later in the sample period has a significant exogenous component associated with shifts in external market forces and changes in the legal environment. First, bankruptcy courts have become more creditor-friendly and less willing to grant extensions of the automatic stay as well as applying stronger enforcement of the Absolute Priority Rule (APR). Also, changes in the legal environment have effectively shortened protection periods and strengthened the bargaining position of creditors. These changes include the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCA), and two Supreme Court level legal cases in 2012 and 2017.<sup>14</sup> <sup>15</sup> In addition to the legislative changes that improved creditor bargaining positions, there is a concurrent change in the prevalence of Debtor-in-Possession (DIP) loans. DIP loans give creditors enhanced control due to having strict conditions (typically) for the borrower and to having short maturities.<sup>16</sup> With stronger creditor bargaining positions, bankrupt

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<sup>13</sup>Li (2013) argues that longer bankruptcy duration is inefficient since it increases the likelihood of excessive risk taking by shareholders. In the data used to parameterize their model, Dou, Taylor, Wang and Wang (2021) show that there is a negative relationship between creditor recovery and bankruptcy duration. Longer time to reorganize exacerbates asymmetric information and agency conflicts that are at the heart of their model.

<sup>14</sup>Multiple aspects of BAPCA make Chapter 11 less debtor friendly, including vastly reducing individual bankruptcy case load and freeing up time for bankruptcy judges, more strongly imposing an 18-month limit on the exclusivity period where the firm is the sole entity that can propose a reorganization plan, increasing the priority of trade credits accrued in the twenty days before filing, etc. Teloni (2015) and Iverson (2018) offer a detailed discussion of the various ways that BAPCA affected Chapter 11 filings.

<sup>15</sup>The first Supreme Court legal case is *RadLAX Gateway Hotel v. Amalgamated Bank* - 2012. The decision solidified the right of unimpaired secured creditors to “credit bid” for the bankrupt firm’s assets using the face value of their debt claims. This has increased creditors’ bargaining power. With credit-bidding, a distressed debt investor like a hedge fund can purchase the secured debt at a discount from financial institutions that are no longer willing to hold the debt, and then credit bid with the face value (not market value) of the debt in Section 363 of the US Bankruptcy Code. Fan (2020) finds that following *RadLAX*, the frequency of Section 363 sales increased from 18% to 29% and the percentage of Chapter 11 cases involving credit bidding increased from 8% to 12%. The second legal case was *Czyzski v. Jevic* in 2017. The decision ruled that bankruptcy courts cannot authorize a distribution of settlement proceeds in a manner that does not comply with the APR, which strengthened bargaining position of junior debtholders.

<sup>16</sup>Dahiya, John, Puri, and Ramirez (2003) document an increase in the frequency of DIP financing between 1998 and 1997 and find that firms receiving DIP financing spend less time in bankruptcy. Eckbo, Thornburn and Wang (2016) find that there is higher forced CEO turnover when the firm’s pre-petition lenders provide DIP financing. Li and Wang (2016) document that hedge funds and private equity have increased their participation in DIP financing and often pursue a loan-to-own strategy. Tung (2017) shows that from 2004 to 2012, there has been a gradual increase in the percentage of DIP loans that impose milestone dates on management for things like filing, court approval of filing, major asset sales, and filing of reorganization plans.

firms have reduced ability to convince courts to extend the protection period, and less option value associated with slow-walking the bankruptcy process. The above observations further justify our assumption that shorter bankruptcies, particularly in the last two decades, are primarily driven by collective effects of external factors and not by endogenous choices of bankrupt firms.

Our model also produces new policy suggestions for bankruptcy courts. If the courts' objective is to preserve firm value, then they should endeavor to keep protection periods shorter, but not completely compress them. An anticipation that courts will not grant a long protection periods will deter distressed firms from entering bankruptcy prematurely. Additionally, shorter protection periods encourage bankrupt firms to commit to sell assets and exit bankruptcy in a timely manner. This can also incentivize creditors and debtors to reach agreement on reorganization plans more quickly, resulting in more cases of lower cost pre-negotiated and pre-packaged bankruptcy filings. The model also recognizes a trade-off that bankruptcy courts are facing, especially during bad market conditions for a bankrupt firm's assets. Courts should allow moderately short bankruptcy periods to incentivize firms to pursue bankruptcy with a commitment to sell assets and avoid premature liquidation.

Our model extends a short list of dynamic models on the Chapter 11 bankruptcy process that implicitly or explicitly incorporate a finite horizon of the protection period and other institutional features of Chapter 11 such as "the automatic stay". The most related papers in this list include Paseka (2003), Broadie, Chernov and Sundaresan (2007), Annabi, Breton, and Francois (2012), Li (2013), Antill and Grenadier (2019), and Dou, Taylor, Wang, and Wang (2021). Most existing models assume an exogenous process for firm assets before and during the Chapter 11 protection period and do not incorporate a decision to downsize and sell assets to restructure debt. This is understandable because these papers focus on different aspects of bankruptcy.<sup>17</sup> In contrast, we focus on asset sales and the pre-announced commitment to sell assets as the key mechanisms for restructuring debt and emerging from bankruptcy as a going concern. We also offer extensive empirical support for our model.

The paper continues as follows. The next section provides a description of the model, calibration,

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<sup>17</sup>Paseka (2003), Annabi, Breton, and Francois (2012), and Antill and Grenadier (2019) model a dynamic negotiation game for splitting (exogenously determined) assets among creditors and shareholders. Dou, Taylor, Wang, and Wang (2021) have a dynamic bargaining game between creditor classes. Broadie, Chernov and Sundaresan (2007) stress debt forgiveness during the protection period as a mechanism for restructuring debt and its effect on optimal capital structure.



and model results and predictions. The subsequent section describes the data and reports empirical tests. The final section concludes the paper.

## 2 Model

### 2.1 Summary of the Model

Our continuous-time model describes a firm that has two separate divisions. Revenue is described by a common stochastic state variable and division-specific production costs are constant. Net income is after-tax revenue minus costs, and it is continuously paid to shareholders. At any time, the firm has the option to sell assets of Division 2 for a known market price.<sup>18</sup> If revenue declines enough and asset prices are high enough, then selling assets of Division 2 and continuing with Division 1 is eventually optimal. If revenue declines further the firm can abandon operations of the remaining division and close down. Depending on parameter values, the firm can close either before or after the sale of Division 2. We first consider an unlevered firm as a baseline. Sale proceeds will be paid to shareholders. Liquidation of all assets occurs when revenue declines to the point that continuation value is zero.

We then consider a levered firm operating with perpetual coupon debt.<sup>19</sup> After making tax-deductible coupon payments and paying taxes, the firm pays out all earnings as dividends.<sup>20</sup> With leverage, filing for bankruptcy protection (Chapter 11) or liquidation (Chapter 7) are additional options if revenue declines. If the firm elects to sell Division 2 assets (either prior to bankruptcy or after declaring bankruptcy), all proceeds must be used to reduce the firm's debt.<sup>21</sup> Additionally, debt is redeemed at face value. Thus, a strict version of the Absolute Priority Rule is one of the model's assumptions.<sup>22</sup> We assume that asset sales outside of bankruptcy can occur only if the

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<sup>18</sup>We do not assume incomplete information between creditors and the borrower regarding asset value as is assumed in Giammarino (1989).

<sup>19</sup>We assume all debtholders are senior. Thus, we do not consider the conflicts and bargaining between different classes of debtholders as discussed in Brown (1989), Brudney (1992), Chatterjee, Dhillon, and Ramirez (1995), Carapeto (2005), and Brunner and Krahen (2008).}

<sup>20</sup>We assume that the firm cannot change its dividend policy and cannot retain any part of its earnings as cash to use for its future interest payments or investments. Allowing cash holdings to vary over time increases the dimensionality of the model and complicates solving it.

<sup>21</sup>In the model we do not differentiate between lender types and do not consider other restructuring venues like exchange offers or private restructuring, as discussed in Jensen (1989), Gilson, Kose, and Lang, (1990), Detragiache and Garella (1996), James (1996), Lie, Lie, and McConnell (2001), Hege, (2003), Hu and Black (2008), Blazy, Martel, and Nigam (2014), Demiroglu and James (2015), Lim (2015), Danis (2016), and François and Raviv (2017).

<sup>22</sup>We have also analyzed a version of the model that incorporates some violation of the Absolute Priority Rule

firm emerges with non-zero equity as a going concern.<sup>23</sup> After selling Division 2, the firm continues operations with the remaining assets of Division 1 and remaining debt. The firm can liquidate via fire-sales if revenue declines further. In liquidation, proportional deadweight costs are applied to the remaining assets.

The firm may also optimally choose liquidation via Chapter 7 without asset sales or filing for Chapter 11 bankruptcy. This occurs when the sale price for assets is too low or debt is so large that, after asset sales, the firm would emerge with greater leverage than before and with a lesser value for the shareholders. In this case, the optimal sales boundary is below the liquidation boundary. With preemptive liquidation, assets of both divisions are sold at fire-sale prices, and going concern value is not preserved - shareholders are wiped out and debtholders take control after incurring proportional deadweight costs. Alternatively, the firm can choose to file for Chapter 11 bankruptcy. When filing for Chapter 11, the firm can either commit to sell assets of Division 2 during the protection period, or to take a wait-and-see approach and not commit to sell. Initial filing for bankruptcy entails immediate fixed transaction costs representing legal and administrative expense. After filing, the bankruptcy court grants the firm “an automatic stay” for a predetermined period. The duration of this “protection period” is exogenous and is known to the firm and markets. The timing of filing for bankruptcy, as well as timing of asset sales during protection period, is fully controlled by shareholders. After filing, the firm stops making coupon payments and distributing dividends. Unpaid coupon payments accrue with interest. This assumes that all creditors are secured, and if the firm recovers, unpaid interest is paid back in full. Revenue net of production costs also accrues with interest and retained. The entire time that the firm is in bankruptcy protection, it incurs continuous costs associated with financial distress and legal expenses. The firm can emerge from bankruptcy before or at the end of the protection period. If the firm chooses to sell assets it emerges from bankruptcy and continues operations with the assets of the remaining division and reduced debt.

Any excess funds from accrued revenue left after accrued coupons are distributed to shareholders. If cash from asset sales and net income are not enough to repay accrued coupons then shareholders can issue additional equity. If it is not optimal for shareholders to raise equity capital, the firm does not emerge from bankruptcy, it liquidates at fire-sale prices, absorbs liquidation costs,

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and some debt forgiveness. The main results remain qualitatively the same.

<sup>23</sup>We disallow asset sale that turns into an immediate liquidation.

and is taken over by debtholders. In the model, if the firm makes a commitment to sell assets, this is a binding commitment and the firm cannot exit the protection period without selling assets of Division 2. Shareholders still can optimally time asset sales to maximize equity value. If at the end of the protection period the equity value is zero, the firm must sell the assets of Division 2 and then immediately liquidate its assets of remaining Division 1. Debtholders then take control after incurring liquidation costs applied to the remaining assets. Liquidation is more possible if revenue remain low during protection period and asset prices are low enough. The firm can emerge from bankruptcy protection if revenue recovers sufficiently to pay off accrued coupons, or by selling Division 2. If the firm emerges from bankruptcy (with or without asset sales) as a going concern, shareholders retain the option to liquidate the firm in subsequent periods.<sup>24</sup>

We assume that both initial fixed transaction costs and financial distress costs that are incurred during bankruptcy are higher when the firm files for bankruptcy without a commitment to sell assets. This assumption reflects that shareholders, debtholders and other participants face more legal disagreements and more risk due to no confirmed plan. Therefore, value erodes faster during bankruptcy with no commitment.

## 2.2 The Firm's Revenue and Asset Sales

The firm produces a continuous revenue stream  $p$ , described by the following stochastic process:

$$\frac{dp}{p} = (r - \alpha)dt + \sigma_p dW_p, \quad (1)$$

where  $W_p$  is a Wiener process under the risk neutral measure  $Q$ ,  $\sigma_p$  is the instantaneous volatility coefficient,  $r$  is the risk free rate, which is assumed to be constant, and  $\alpha$  ( $\alpha > 0$ ) is the convenience yield.

The firm has two divisions - a core Division 1 and a subsidiary Division 2. Division 1 generates a fraction  $Q_1$  of revenue while Division 2 generates the remainder  $Q_2$ . Each division has its own continuous production costs of  $c_1$  and  $c_2$ , respectively. Thus, the firm's instantaneous earnings before interest and taxes (EBIT) equals  $(p \cdot Q_1 - c_1)$  plus  $(p \cdot Q_2 - c_2)$ .

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<sup>24</sup>For technical simplicity, we assume that after emerging from bankruptcy, the firm cannot enter bankruptcy again. This is a common assumption of the related literature. Also, if the firm emerges from Chapter 11 without asset sales, it cannot subsequently sell assets.

### 2.3 Debt, Corporate Taxes And Dividends

We assume that the firm issues perpetual coupon debt with a periodic coupon payment  $d$ . The firm's earnings after interest payments are taxed continuously at a constant corporate rate,  $\lambda$ , and coupon payments are tax deductible. All residual earnings after interest payments and taxes are paid out as dividends. The firm's instantaneous after tax dividends are:

$$(1 - \lambda) \cdot [p \cdot Q' - c' - d'], \quad (2)$$

where  $d'$  represents periodic debt payments, and output  $Q'$  equals either  $Q_1 + Q_2 = 1$ , before asset sales, or  $Q_1$  after asset sales. Similarly,  $c' = c_1 + c_2$ , or  $c_1$ .

### 2.4 The Unlevered Firm

We begin by valuing an unlevered firm after the asset of Division 2 are sold. The firm's after tax earning are then  $(1 - \lambda) \cdot [p \cdot Q_1 - c_1]$ . If revenue declines to critical value  $p_A$ , the firm abandons operations and closes down with zero recovery value. The price at which the firm operating with Division 1 only abandons operations is

$$p_{A_q} = \frac{c_1}{Q_1} \left( \frac{-\beta_2}{(1 - \beta_2)} \right) \frac{\alpha}{r}, \quad (3)$$

and the unlevered firm value after asset sales is:

$$V_{U_q}(p) = (1 - \lambda) \cdot [(Q_1 \cdot p/\alpha - c_1/r) - (Q_1 \cdot p_{A_q}/\alpha - c_1/r) \cdot (p/p_{A_q})^{\beta_2}], \quad p > p_{A_q}, \quad (4)$$

$$\text{where } \beta_2 = 0.5 - (r - \alpha)/\sigma^2 - \sqrt{[(r - \alpha)/\sigma^2 - 0.5]^2 + (2r/\sigma^2)} < 0. \quad (5)$$

Assume that the sale price of assets of Division 2 is  $S$ . With no debt, sale proceeds are paid out to shareholders. Thus, the value of the unlevered firm before it sells Division 2 has to satisfy the following equation:

$$V_U(p) = [(1-\lambda) \cdot (p/\alpha - (c_1+c_2)/r) - \{(1-\lambda) \cdot (p_{us}/\alpha - (c_1+c_2)/r) - V_{Uq}(p_{us}) - S\} \cdot (p/p_{us})^{\beta_2}], \quad p > p_{us} > p_{Aq}, \quad (6)$$

where revenue  $p_{us}$  which triggers sale of Division 2 has to satisfy the following equation:

$$\frac{\partial V_U(p_{us})}{\partial p} = \frac{\partial V_{Uq}(p_{us})}{\partial p}, \quad \text{and } V_U(p_{us}) = V_{Uq}(p_{us}) + S. \quad (7)$$

This can be solved numerically.

## 2.5 Levered Firm That Can Sell Its Assets Outside Bankruptcy or Liquidate, but Cannot File for Bankruptcy Protection

We next consider a levered firm that operates with debt having a tax-deductible continuous coupon payment of  $d$ . We first consider the case where the firm can sell assets of Division 2 outside of bankruptcy or liquidate without asset sales, but cannot pursue bankruptcy. The shareholders time asset sales to maximize equity value. If the firm sells Division 2, all sale proceeds  $S$  must be used to pay down debt. This reduces the coupon from  $d$  to  $d_1 = d - S \cdot r$ .<sup>25</sup>

Similar to the previous section, we start with the levered firm after it has sold assets of Division 2. After-tax residual dividends are  $(1-\lambda) \cdot [p \cdot Q_1 - c_1 - d_1]$ . If revenue declines to critical value  $p_{d_1}$ , at which the equity value is zero, shareholders abandon the firm and debtholders take control of the unlevered assets minus proportional fire-sale liquidation costs,  $DC$ . At liquidation, the shareholders have zero recovery value. It is straightforward to show that the price at which shareholders optimally liquidate is

$$p_{d_1} = \frac{c_1 + d_1}{Q_1} \left( \frac{-\beta_2}{(1-\beta_2)} \right) \frac{\alpha}{r}. \quad (8)$$

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<sup>25</sup>We parameterize the model so that initial debt is greater than proceeds from assets sales, i.e.,  $\frac{d}{r} > S$ . Thus, the firm continues with non-zero debt following the sale of Division 2.

The values of debt and equity after selling Division 2 satisfy the following equations:

$$E_1(p, d_1) = (1 - \lambda) \cdot [Q_1 \cdot p/\alpha - c_1/r - d_1/r] - (Q_1 \cdot p_{d1}/\alpha - c_1/r - d_1/r) \cdot (p/p_{d1})^{\beta_2}, \quad (9)$$

$$D_1(p, d_1) = d_1/r - [d_1/r - (1 - DC) \cdot V_{Uq}(p_{d1})] \cdot (p/p_{d1})^{\beta_2}, p_{d1} > p_{Aq}. \quad (10)$$

Before asset sales, the value of equity and debt of the levered firm must satisfy the following equations:

$$E_0(p, d) = (1 - \lambda) \cdot (p/\alpha - (c_1 + c_2 + d)/r) - [(1 - \lambda) \cdot (p_s/\alpha - (c_1 + c_2 + d_1))/r - E_1(p_s, d_1)] \cdot (p/p_s)^{\beta_2}, \quad (11)$$

$$D_0(p, d) = d/r - [d_1/r - D_1(p_s, d_1)] \cdot (p/p_s)^{\beta_2}, p > p_s > p_{d1}, \quad (12)$$

where  $p_s$  is revenue at which equityholders optimally sell Division 2. At that point, equity value has to satisfy the following equations that reflect smooth pasting and maximization conditions:

$$\frac{\partial E_0(p_s, d)}{\partial p} = \frac{\partial E_1(p_s, d_1)}{\partial p}, \text{ and } E_0(p_s, d) = E_1(p_s, d_1), \quad (13)$$

which can be solved numerically for  $p_s$ . At the asset sales trigger  $p_s$ , the debt value is  $D_0(p_s, d) = D_1(p_s, d_1) + S$ . This reflects the assumption that all sale proceeds are used to reduce debt.

If the coupon payment  $d$  is large enough relative to the sale price  $S$ , the value of the equity can become zero or negative at revenue  $p_s$  that satisfies the condition 13. In such a case, the shareholders optimally choose not to sell assets and simply liquidate the firm when revenue declines to  $p_{ns}$ , ( $p_{ns} > p_s$ ). The subscript  $ns$  stands for the liquidation trigger with "no sale" of assets. At this point, equity value is zero. In other words, for small enough price  $S$  or large enough debt, the sale option is worthless for shareholders because the liquidation decision (without asset sales) has greater equity value,  $E_0^{ns}(p, d)$ , i.e.,  $E_0(p, d) < E_0^{ns}(p, d)$ , for any  $p > p_{ns}$ , where:

$$E_0^{ns}(p) = (1 - \lambda) \cdot [(p/\alpha - c/r - d/r) - (p_{ns}/\alpha - c/r - d/r) \cdot (p/p_{ns})^{\beta_2}], p_{ns} > p_{A_q}, \quad (14)$$

$$p_{ns} > p_s, p_{ns} > p_A, \quad (15)$$

$p_{ns}$  is the optimal liquidation trigger at which equityholders liquidate the firm with no prior asset sales. It is straightforward to show that the optimal liquidation trigger is

$$p_{ns} = (c + d) \left( \frac{-\beta_2}{1 - \beta_2} \right) \frac{\alpha}{r}. \quad (16)$$

The debt value for the case when  $p_{ns} > p_s$  is

$$D_0^{ns}(p, d) = d/r - [d/r - (1 - DC) \cdot V_U(p_{d_{ns}})] \cdot (p/p_{ns})^{\beta_2}. \quad (17)$$

Thus, the debt and equity values of the firm that can sell assets, but that has no option to enter bankruptcy is

$$E_{No\_Filing}(p, d) = \max \begin{cases} E_0(p, d), & \text{if } p > p_s > p_{d_1}, p_s > p_{ns}, \text{ the firm sells assets} \\ E_0^{ns}(p), & \text{if } p > p_{ns} > p_s, \text{ i.e., the firm is} \\ & \text{liquidated without asset sales.} \end{cases} \quad (18)$$

$$D_{No\_Filing}(p, d) = \begin{cases} D_0(p, d), & \text{if } p > p_s > p_{d_1}, p_s > p_{ns}, \text{ the firm sells assets} \\ D_0^{ns}(p), & \text{if } p > p_{ns} > p_s, \text{ i.e., the firm is} \\ & \text{liquidated without asset sales.} \end{cases} \quad (19)$$

**Proposition:** For a critical level of asset sale price  $S^* = \frac{c_1 + d - (c + d)Q_1}{r}$ , for which  $p_{d_1} = p_{ns}$ , and  $E_0(p_{d_1}, d) = E_0^{ns}(p_{d_1}, d_1) = 0$ , the shareholders are indifferent between liquidating the firm without selling assets or selling assets and then immediately liquidating the firm. If  $S < S^*$ , then  $p_{d_1} > p_{ns}$ , and shareholders optimally liquidate without selling assets as soon as revenue declines to  $p_{ns}$ .

## 2.6 Levered Firm That Can File for Bankruptcy Without Commitment to Sell Assets

In this section, we analyze the levered firm that has an option to pursue Chapter 11 bankruptcy. We first evaluate the firm that enters bankruptcy without commitment to sell assets during the protection period. The evaluation of the firm that chooses to commit to asset sales is similar. After filing, an automatic stay is enacted and the firm does not make interest payments or pay dividends for the duration of the protection period or until the firm is liquidated or emerges from bankruptcy. The protection period is known to the firm and markets.

As is frequently discussed, Chapter 11 is associated with various costs for the bankrupt firm. First, at the time of filing, the firm pays a one-time transaction cost which corresponds to one-time legal, advisory and filing fees. Second, for the length of the bankruptcy period the firm incurs continuous costs that are a fraction of earnings,  $p \times c_{no\_comm}$ , where  $c_{no\_comm}$  is a positive constant. These costs represent distress costs due to a possible loss of employees and customers as well as ongoing administrative and legal expenses, both of which can be high because of the uncertainty of bankruptcy outcomes.

Unpaid interest payments as well as net earnings accrue in separate accounts and grow at the risk-free rate. The firm emerges from bankruptcy in one of two ways: First, any time before the protection period expires, the firm can decide to sell assets of Division 2. Proceeds are then used to pay off accrued interest. Accrued net earnings are also used to pay accrued interest payments. Once accrued interest is paid, remaining funds are used to pay down debt. If there are insufficient funds to pay off accrued interest, then the remaining amount must be covered with proceeds of newly issued equity. Second, the firm may be able to emerge from bankruptcy without selling assets. This occurs if stochastic revenue  $p$  recovers significantly during the protection period. In most cases, the firm will then be less levered than when filing for bankruptcy. As mentioned previously, regardless of how the firm exits bankruptcy, it will have no further option to declare bankruptcy again or to sell assets.

In bankruptcy, the net earning account where earnings accrue  $N$ , is described as

$$dN(t) = (rN + p - p \times c_d - c_1 - c_2 - (\lambda) \cdot [p - c_1 - c_2 - d])dt, \text{ and where } N(0) = 0. \quad (20)$$



The last term represents taxes (or tax credits) that accrue during the protection period. The dynamics for the unpaid interest account,  $U(t)$ , are described as:

$$dU(t) = (rU + d)dt, \text{ and } U(0) = 0. \quad (21)$$

Its value can be calculated forward for each  $t$ ,  $t \leq T$ , using the future value of a continuously compounded annuity:  $U(t) = d \frac{e^{r \cdot t} - 1}{e^r - 1}$ .

### 2.6.1 Firm Valuation Within the Protection Period

Given interest payments of  $d$ , the value of the firm's equity  $E(p, N, U, t)$  within the protection period is a function of revenue,  $p$ ; accrued net earnings,  $N$ ; accrued interest  $U$ ; and the time elapsed  $t$  since filing,  $0 \leq t \leq T$ , where  $T$  is the maximum allowed protection period.

Because the only option remaining for the firm after exiting bankruptcy is the option to liquidate, the value of equity and of debt are known. Specifically, the value of the firm's equity is equal to the following:

$$E(p, N, U, T) = \max \left\{ \begin{array}{ll} E_1(p, d_1) + N(T) - U(T), & \text{the firm sells assets at } t = T. \\ E_0^{ns}(p) + N(T) - U(T), & \text{the firm emerges from bankruptcy} \\ & \text{without asset sales.} \\ 0, & \text{the firm is liquidated at } t = T. \end{array} \right. \quad (22)$$

When accrued net earnings cannot pay for all unpaid coupons, i.e., if the net earnings account is less than unpaid coupon account, i.e.,  $U(T) > N(T)$ , the firm has to issue equity to cover the difference, if the firm emerges from bankruptcy. The debt value at  $t = T$  depends on the firm's decisions:

$$D(p, N, U, T) = \begin{cases} D_1(p, d_1) + S + U(T), & \text{the firm sells assets} \\ D_0^{ns}(p) + U(T), & \text{the firm emerges from bankruptcy without asset sales.} \\ (1 - DC)V_U(p) + N(T), & \text{if } E_2(p, N, U, T) = 0, \text{ the firm} \\ & \text{is liquidated at } t = T. \end{cases} \quad (23)$$

For time  $0 \leq t < T$ , the firm chooses when to sell assets and when to emerge from Chapter 11 with the objective of maximizing the market value of equity,  $E(p, N, U, t)$ . The solution involves determining free boundary conditions that divide the state space  $(p, N, U, t)$  into three regions that characterize the firm's choices: the *no action region*, the *asset sales region*, and the *liquidation region*.<sup>26</sup>

Using standard arbitrage arguments outlined in Merton (1974)<sup>27</sup>, for  $0 \leq t < T$ , the value of the equity and debt in the *no action region* is given by the solution to the following PDE:

$$\frac{\sigma^2 p^2}{2} \frac{\partial^2 E}{\partial p^2} + (rN + p - c_1 - c_2 - (\lambda) \cdot [p - p \times c_d - c_1 - c_2 - d]) \frac{\partial E}{\partial N} + (rU + d) \frac{\partial E}{\partial U} - \frac{\partial E}{\partial t} - rE = 0, \quad (24)$$

$$\frac{\sigma^2 p^2}{2} \frac{\partial^2 D}{\partial p^2} + (rN + p - c_1 - c_2 - (\lambda) \cdot [p - p \times c_d - c_1 - c_2 - d]) \frac{\partial D}{\partial N} + (rU + d) \frac{\partial D}{\partial U} - \frac{\partial D}{\partial t} - rE = 0, \quad (25)$$

The equation is not time-homogeneous because the protection period has finite length and the term  $\frac{\partial E}{\partial t}$  represents the change in equity value due to continuous changes in elapsed time within the protection period. Thus, there is no steady state solution for the firm's value and no closed-form solution.

The shareholders optimally decide to sell assets if the net benefit of sales and subsequent emergence from bankruptcy exceeds the equity value when the firm continues to operate under

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<sup>26</sup>For brevity, we omit discussion of the technical detail of the boundary and "high contact" conditions that apply to the value function  $E$ . For details see Oksendal and Sulem (2007).

<sup>27</sup>Merton (1974) shows that in a complete market, any security, that is a function of the underlying security  $p$  and time  $t$ , can be replicated by continuously rebalancing a portfolio of futures contracts and risk-free bonds. Therefore the security value  $V(p, t)$  has to satisfy the following equation  $\frac{1}{2}\sigma^2 p^2 V_{pp} + (r - \alpha)pV_p - rV + CF(p, t) + V_t = 0$ , where  $CF(p, t)$  is cash flow rate to the security holders.

Chapter 11 protection. Similarly, the firm decides to emerge from bankruptcy without selling assets if the net benefit exceeds the continuation option. The equity value in this region can be determined by the following:

$$E(p, N, U, t) = \max \left\{ \begin{array}{l} e^{-rdt} \mathbb{E}^Q \{ E(p, N, U, t + dt) \}, \text{ the firm continues to operate} \\ \text{under Chapter 11 protection} \\ E_1(p, d_1) + N(t) - U(t), \text{ the firm sells assets and} \\ \text{emerges from bankruptcy} \\ E_0(p, d) + N(t) - U(t), \text{ the firm emerges} \\ \text{from bankruptcy without asset sales.} \end{array} \right. \quad (26)$$

$$D(p, N, U, t) = \left\{ \begin{array}{l} e^{-rdt} \mathbb{E}^Q \{ D(p, N, U, t + dt) \}, \text{ the firm continues to operate} \\ \text{under Chapter 11 protection} \\ D_1(p, d_1) + S + U(t), \text{ the firm sells assets} \\ \text{and emerges from bankruptcy} \\ D_0^{ns}(p) + U(t), \text{ the firm emerges from} \\ \text{bankruptcy without asset sales.} \end{array} \right. \quad (27)$$

where  $\mathbb{E}_t^Q$  is the expectation operator under the risk neutral measure  $Q$ .

### 2.6.2 Firm Valuation Before Filing for Chapter 11 Without Commitment

Denote the revenue  $p_{Ch11}$  as the trigger at which the shareholders elect to file for Chapter 11 bankruptcy without commitment to asset sales. By assumption, when the firm files for Chapter 11, it pays a one-time filing and administrative fee,  $C_{Ch11}$ . The values of debt and equity satisfy the following equations:

$$E_{Ch11}(p, d) = (1 - \lambda) \cdot (p/\alpha - (c_1 + c_2 + d)/r) - [(1 - \lambda) \cdot (p_{Ch11}/\alpha - (c_1 + c_2 + d_1)/r) - E(p_{Ch11}, 0, 0, 0) + C_{Ch11}] \cdot (p/p_{Ch11})^{\beta_2}, \quad p > p_{Ch11}. \quad (28)$$

At this revenue  $p_{Ch11}$  the value of equity has to satisfy the smooth pasting and value maximization conditions:

$$\frac{\partial E_{Ch11}(p_{Ch11}, d)}{\partial p} = \frac{\partial E(p_{Ch11}, 0, 0, 0)}{\partial p}, \text{ and } E_{Ch11}(p_{Ch11}, d) = E(p_{Ch11}, 0, 0, 0)$$

which we solve numerically for  $p_{Ch11}$ . The debt value is

$$D_{Ch11}(p, d) = d/r - [d/r - D(p_{Ch11}, 0, 0, 0)] \cdot (p/p_{Ch11})^{\beta_2},$$

and, at  $p = p_{Ch11}$ , the debt value  $D_{Ch11}(p_{Ch11}, d) = D(p_{Ch11}, 0, 0, 0)$ .

The valuation of debt and equity for bankruptcy with commitment is similar to that with no commitment, but needs to be slightly adjusted to incorporate that the firm must sell assets by the end of the protection period. As a result, the optimal entry into bankruptcy  $p_{comm}$  is different too. The details are in the Appendix.

### 3 Model Results

#### 3.1 Base Case Parameters

Most parameter values that describe the firm and its cash flows have been calibrated in numerous Leland-type models. To save space we do not repeat a calibration analysis and instead use parameters from published papers. The volatility of revenue  $\sigma$  is set at 20%. The yield  $\alpha$  is set at 7%. The risk-free interest rate is set to  $r = 7\%$ , this means that the risk neutral drift of revenues is zero. We assume that the production capacity of Division 1 and Division 2 are the same, so that  $Q_1 = Q_2 = 0.5$ . The production costs are the same as well:  $c_1 = c_2 = 1.5$ , and  $c = 3.0$ . Thus, the two divisions have the same productivity. The sale price for Division 2 assets is set at  $S = 12.0$ . For the base case, we set the annual debt coupon at  $d = 1.61$ . We assume the debt is issued at par. Thus, with a yield of 7%, its face value is  $D = \frac{d}{r} = 23$ . For this parameterization, if the firm sells half of its assets for  $S = 12$ , it can reduce debt by slightly more than half.<sup>28</sup> This combination of parameters sets the asset sale boundary  $p_s$  above, but relatively close, to the liquidation boundary

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<sup>28</sup>As we assumed, the firm has to repurchase the debt at face value.

$p_{ns}$ , so that the model produces non-trivial results. As we show later, if the asset sales price is sufficiently low (or debt size is high), the levered firm never sells assets, and liquidates without asset sales when its revenue falls. Conversely, if the sale price is too high (debt size is low), the firm always sells assets outside bankruptcy for most combinations of parameters.

To calibrate the transaction costs of bankruptcy, we collect data on total legal fees of free-fall, pre-negotiated, and pre-packaged bankruptcies as a percentage of pre-bankruptcy total assets. From 1990 until 2020, average estimated legal and other fees for free-fall Chapter 11, pre-negotiated, and pre-packaged bankruptcies are 3.5%, 2.4% and 1.45%, respectively.<sup>29</sup> Thus, fees for free-fall bankruptcies are about 1.5 times more than those for pre-negotiated filings, and more than twice the fees for prepackaged filings.

In the base case, the firm sells half of its productive capacity for  $S = 12.0$ , which implies that market value of the firm is about  $2.0 \cdot S$ . Thus, for the base case, filing fees for Chapter 11 are  $C_{Ch11} = (2.0 \cdot S) \cdot 1.0\%$ , i.e., 2% as a percentage of assets, and half of it for bankruptcies with commitment, i.e.,  $C_{comm} = 0.5 \cdot C_{Ch11}$ . Distress and administrative costs incurred by the firm during bankruptcy are  $c_d = 10\%$  of revenue  $p$  for bankruptcy without commitment and half that for bankruptcies with commitment.<sup>30</sup> As discussed, this parameterization reflects that in bankruptcies with no commitment, losses due to ongoing legal expense and financial distress costs are higher, due to higher uncertainty regarding the outcome of the bankruptcy. Proportional fire-sale liquidation costs,  $DC = 0.5$ , make liquidation costlier than orderly asset sales.<sup>31</sup>

The average (median) duration of the protection period observed for free-fall and for pre-negotiated bankruptcies is 649 days (502 days) and 254 days (158 days), respectively. Observed protection periods for pre-packaged are much shorter at around 60 days. Thus, we assume that the maximum length of the protection period in the model,  $T$ , is varied between 0 and 2 years (365 days). As previously noted, the duration of the maximum protection period is exogenous. However, the firm can decide to emerge from bankruptcy before the end of the protection period. Thus, the actual bankruptcy duration is endogenous for both bankruptcy types, but not longer than  $T$ . The

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<sup>29</sup>Tashjian, Lease, and McConnell (1996) estimate direct costs of bankruptcy for pre-packaged filings to be 1.8% of pre-filing assets. Betker (1997) estimates direct costs of 2.85% for pre-packaged filings and 3.93% for traditional Chapter 11 filings. Other direct cost estimates include Lopucki and Doherty (2001) - 1.4% of pre-filing assets, and Bris, Welch and Zhu (2006) - 1.9% of pre-filing assets.

<sup>30</sup>Bris, Welch, and Zhu (2006) show that firm liquidation is likely more expensive than Chapter 11.

<sup>31</sup>The size of proportional default costs is comparable with the recovery rates in the U.S. corporate bonds documented in Jankowitsch, Nagler, and Subrahmanyam (2014).

model focuses on how changes in the anticipated length of the protection period affect decisions of firms both before and during bankruptcy.

## 3.2 Model Solutions

### 3.2.1 Unlevered Firm

We first consider the properties of the solution for an unlevered firm in the base case. The calculations show that the firm optimally triggers assets sales at revenue  $p_{us} = 3.75$ . After the assets are sold, the firm continues operations with Division 1 and optimally closes its operations when revenue declines further to  $p_{A_q} = 2.01$ .

### 3.2.2 Base Case: Levered Firm With No Option to File for Bankruptcy

Second, we analyze a levered firm that cannot pursue bankruptcy, but that has the option to sell assets or liquidate. For the base case parameters, the critical sale price for assets of Division 2 is  $S^* = \frac{c_1 + d - (c + d)Q_1}{r} = 11.5$ . As we have shown, for sale price  $S = 12.0 > S^*$ , shareholders optimally choose to sell assets first and then liquidate the remaining assets if revenue declines further. Otherwise, if  $S^* > S$ , the firm liquidates without selling assets. Given that the sale price is  $S = 12$ , it means that the firm sells half of its production capacity ( $Q_2 = 0.5$ ), and the sale proceeds reduce debt. This holds for the base case where the debt (total coupon) declines by more than half. For the base case, sale proceeds reduce debt from  $D = 23.0$  to  $D_1 = 11.0$ .

From solutions of the optimization problem in 13, the revenue which triggers the levered firm to sell assets of Division 2 is  $p_S = 3.14$ . This revenue is lower than  $p_{us} = 3.75$ , at which the unlevered firm optimally executes asset sales, i.e., it is a delayed asset sale. This is a form of the debt overhang problem which we call “delayed disinvestment”. It occurs because asset sales disproportionately benefit debtholders at the expense of shareholders. At the asset sales boundary ( $p_S = 3.14$ ), the firm’s market leverage ratio – measured as market value of debt divided by the market value of the unlevered company – declines from  $\frac{D_0(p_S, d)}{V_U(p_S)} = 96\%$  to  $\frac{D_1(p_S, d_1)}{V_U(p_S)} = 69\%$ .

### 3.2.3 Base Case: The Choice Between Selling Assets Outside of Bankruptcy or Filing for Bankruptcy

We compare the decisions and outcomes for the three firm types: 1) the firm that cannot file for bankruptcy but can sell assets outside bankruptcy or liquidate, 2) the firm that can file for bankruptcy without committing to sell assets, and 3) the firm that can enter bankruptcy and commits to sell assets during the bankruptcy. Ultimately, a firm simultaneously has all three choices and must settle on the one that gives the highest equity value. However, it is easier to understand this choice if we provide results separately for the three firm types.

The optimal timing for when a firm files for bankruptcy with or without commitment depends on the anticipated length of the protection period. Figure 3, Panel 1 presents the model generated values for the three firm types as a function of the maximum bankruptcy duration and assuming that  $S = 12$ .

The first of the six graphs in Figure 3, Panel 1 displays the three revenue triggers. The first,  $p_s$ , is the revenue level at which the firm with no option to file bankruptcy sells assets. The second,  $p_{comm}$ , is the revenue level at which a firm that commits to sell assets files for bankruptcy. Finally,  $p_{Ch11}$ , is the revenue level at which a firm that does not commit to sell assets files for bankruptcy. The graph shows that the firm optimally files for bankruptcy (for either method) at higher revenue levels if the allowable bankruptcy duration is longer. The result holds for all durations, except when the protection duration is very short. Thus, we have the following prediction:

**Prediction 1:** If the distressed firm expects a longer protection period, it files for bankruptcy earlier at lower stages of distress, (i.e., at higher revenue and earnings), and at lower leverage for both bankruptcy methods.

The intuition is that a longer protection period gives shareholders greater option value so that they optimally file earlier (at lower leverage ratios) to temporarily stop incurring cash flow losses. The effect is stronger for filings without commitment to sell assets because the firm can potentially emerge from bankruptcy with both divisions intact.<sup>32</sup>

Next, we compare equity values for when the firm has all three choices and describe the firm's trade-offs. Without loss of generality, the equity values for each of the three firm types are measured

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<sup>32</sup>As noted earlier, Adler, Capkun, and Weiss (2013) document that firms typically file when they are in deeper stages of distress as their sample progresses from 1993 to 2004.

at revenue  $p = 6.0$ . This is greater than the revenue that triggers assets sales for the firm that cannot pursue bankruptcy. It is also greater than the revenue that triggers filing for bankruptcy with either method. If the protection period is short, equity value is greatest when the firm sells assets outside of bankruptcy. Specifically, for the base case, if the maximum bankruptcy duration allowed by the court is shorter than 0.27 years, shareholders do not enter bankruptcy (of either type), but prefer to sell assets outside bankruptcy when revenue declines from  $p = 6$  to  $p_s$ . If the protection duration is longer than 0.27 years, equity value is greatest if the firm pursues bankruptcy, even though the total value of the firm is lower than if the firm sells assets without entering bankruptcy.

This decline in value is due to distorted incentives leading to a delayed asset sale and unnecessary higher expected financial distress costs incurred during bankruptcy, which are ultimately borne by debtholders. The expected value losses are especially large for no-commitment bankruptcy and when the protection period is long. The losses are also driven by delays in asset sales due to no-commitment.

Now consider the factors that affect the choice between bankruptcy with and without commitment to sell assets. The second graph in Figure 1, Panel 1 reveals the following predictions. If the length of the protection period is in an intermediate range (between 0.27 and 1.05 years), equity value of the firm that files for bankruptcy with commitment is greater than that for bankruptcy without commitment. Thus, the firm chooses to enter bankruptcy with a commitment to sell assets. When a longer protection period is allowed by the courts (longer than 1.05 years), the firm pursues bankruptcy with no commitment. The above observations lead to the following prediction:

**Prediction 2:** When longer protection periods are allowed by the bankruptcy courts, shareholders are more likely to pursue bankruptcy without committing to sell assets than bankruptcy with commitment.

The main trade-off is the following. Bankruptcy without commitment is associated with higher filing fees and financial distress cost, which is offset by the higher optionality during bankruptcy. If the protection period is long, this optionality has higher value, making bankruptcy without commitment more attractive. The graphs also reveal another important implication regarding the timing of Chapter 11 filing:

**Prediction 3:** Holding the duration of the protection period constant, the firm chooses to pursue bankruptcy with a commitment to sell assets when it reaches deeper stages of distress (i.e. at lower revenue and earnings, and higher leverage) compared to bankruptcy without commitment.



The reason is that commitment to sell assets during the protection period reduces the optionality value for shareholders, so they postpone filing for bankruptcy. A longer protection period increases optionality value disproportionately more for bankruptcy without commitment, reducing incentives for shareholders to make such a commitment. Furthermore, as depicted in Figure 3, Panel 1, the probability that the firm sells assets during the protection period when in bankruptcy without commitment is lower when the protection period is longer. Specifically, this probability is only around 5% for bankruptcy durations longer than 0.5 years. This leads to the following prediction:<sup>33</sup>

**Prediction 4:** For the firm that files for bankruptcy without commitment to sell assets, the probability of asset sales during the protection period declines as the duration of the protection period lengthens.

This prediction implies that for bankruptcy filing without commitment, a long protection period may further distort incentives to sell assets during the protection period, leading to greater value losses and a higher likelihood of fire-sale liquidation. The third graph in Figure 3, Panel 1, depicts the expected liquidation probability.<sup>34</sup> The liquidation can happen if revenue subsequently drops during the bankruptcy, with or without asset sales, as well as after a successful emergence from bankruptcy. The figure implies the following prediction:

**Prediction 5:** In bankruptcy with no commitment to sell assets, the probability of subsequent liquidation is greater than that for bankruptcy with commitment and the expected liquidation probability increases as protection duration lengthens.

This result might seem surprising because the firm enters bankruptcy without commitment at earlier stages of distress than for bankruptcy with commitment. Asset sale probability and liquidation likelihood are interrelated and depend on the realized path of the firm's revenue during the protection period. On a path where revenue is low and both accrued unpaid coupons as well as financial distress losses are large relative to accrued earnings, incentives to sell assets are reduced. As a result, with longer remaining protection, there is a greater likelihood of liquidation. This prediction also holds for bankruptcy with commitment to sell assets, but the impact is significantly less pronounced.

These predictions are key for our analysis and highlight that bankruptcy without commitment

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<sup>33</sup>The conditional probability of asset sales is calculated under the real probability space. We transition from the risk-neutral probability space to real probability space by adjusting the drift of the product price upward by 20%.

<sup>34</sup>This is a conditional probability that the firm, starting with revenue of  $p = 6.0$ , subsequently liquidates for each firm type.

may exacerbate the “delayed disinvestment” problem by delaying or even completely disincentivizing asset sales, even though it could be beneficial to firm value. This is particularly true for longer protection periods. As a policy recommendation, our model suggest that bankruptcy courts should create expectation of a shorter protection period to discourage premature filing for bankruptcy in the early stages of distress. By not granting a long protection period, courts encourage distressed firms to switch to bankruptcy deals with a commitment to sell assets, potentially preserving firm value.

### 3.2.4 Comparative Statics: Different Sale Prices for the Firm’s Assets

We now analyze the model given unfavorable market conditions for the firm’s assets, where the market price  $S = 11$ . This price is below the critical level of  $S^* = 11.5$ . For this price, if the firm sells half of its assets, the sale proceeds will reduce debt by less than half, resulting in greater leverage post-sale. Most predictions regarding the firm’s decisions highlighted above are still qualitatively the same. What is different is the welfare effects of Chapter 11 and policy implications. At a low asset price, the liquidation boundary is above the asset sale boundary so that it is never optimal for shareholders to sell assets outside bankruptcy.<sup>35</sup>

As Figure 3, Panel 1 shows, if the firm has an option to pursue bankruptcy, this choice can be viable for shareholders, depending on the bankruptcy duration. With a very short protection period, shareholders choose to abandon the firm and liquidate without asset sales since proceeds from selling a division will be too low to reduce leverage. With a long protection period, shareholders file for Chapter 11 with no commitment to sell assets. While this is optimal from the perspective of shareholders, firm value suffers due to the higher expected costs of bankruptcy and financial distress. Finally, for intermediate durations, shareholders prefer a bankruptcy with commitment. This choice maximizes total firm value, and debtholders will benefit as well, implying a hump-shaped relationship between the firm value and the length of the protection period. Thus, the option to declare Chapter 11 bankruptcy with a commitment to sell assets may now enhance firm value during unfavorable market conditions, reversing the “delayed disinvestment” problem.

We further explore how firm decisions are affected by the interaction of asset sale price and bankruptcy protection duration. To help understand their combined effects, Chart A reports the

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<sup>35</sup>In this comparative static, parameters for filing fees are kept the same as those for the base case.

firm's decisions for sale price (rows) and bankruptcy duration (columns). The higher the asset sale price, the more likely the firm sells assets outside bankruptcy. A greater sale price also makes bankruptcy with the commitment to sell assets more attractive relative to no-commitment bankruptcy as equity value in the former is more sensitive to sale price. In the table, asterisks indicate the bankruptcy duration at which, given shareholders' choice, firm value is maximized for each asset sale price. As the table shows, for each asset price level, there is a range of protection durations where a decision to declare bankruptcy can be value-maximizing, benefiting both shareholders and creditors.

This sweet spot for protection periods is of intermediate length, i.e., not too short or too long. In the intermediate protection period sweet spot, shareholders will file for Chapter 11 with a commitment to sell assets. The moderate duration limits the option value that shareholders get by waiting for a potential recovery in profitability. With the resulting commitment to sell assets, less value is lost to bankruptcy and financial distress costs as there is certainty that the firm will sell assets in an orderly manner and may successfully reorganize.

When asset price is low, the policy recommendation is quite subtle as bankruptcy courts face a delicate balance where the protection period should not be too short or too long. If courts allow only very short bankruptcy duration, the distressed firm will choose an early suboptimal liquidation. On the other hand, when the protection period is too long, the firm will pick bankruptcy without commitment, leading to even greater losses. Overall, if the courts' objective is to preserve firm value, then they should strive to keep protection periods shorter, but not completely compress them.

## **4 Empirical Analysis**

### **4.1 Summary of the Empirical Approach**

Our empirical analysis focuses on testing the predictions of the theoretical model. We center our attention on six key characteristics of the bankruptcy process and of firms filing for bankruptcy. The first characteristic is a firm's expectations for how long the bankruptcy process is likely to last. To proxy for this expectation, we use the median duration of bankruptcies over the prior two years at the national level and at the individual court district level. Second, we analyze the financial health of bankrupt firms using financial statements recorded prior to the bankruptcy filing to assess

whether the firm is filing early, before they are in deep financial distress, or later when financial distress is significant. Third, we rely on statements made by firms prior to filing for bankruptcy to determine whether there is a pre-commitment to sell assets as a part of the reorganization process. Fourth, we determine whether the firm actually sold significant assets as part of the reorganization process. Fifth, we assess whether the bankruptcy concluded by successful reorganization and exit as an independent company, by merger or acquisition in total by another firm, or by liquidation or conversion to Chapter 7. Finally, for firms that emerge as independent companies and file financial statements once the bankruptcy concludes, we quantify the extent to which Net PP&E as well as number of employees change from pre-bankruptcy levels.

## 4.2 Data Description

Our source for bankruptcy data is the UCLA-Florida-Lopucki Bankruptcy Research Database. This database reports details on all Chapter 7 and Chapter 11 bankruptcy filings since October 1979 where the firm filed a 10-k with the Securities and Exchange Commission within three years prior to the bankruptcy filing and where total assets were at least \$100 million in 1980 dollars as of the last 10k. The Lopucki database reports more than 200 fields, including items such as the filing date, the district where the bankruptcy was filed and the judge that was assigned, whether the filing was pre-packaged, pre-negotiated, or a free-fall filing, etc. Notably, the database also includes the Compustat GVKEY for each filer when a clean match can be made.

There are 1,203 filings as of the date that we downloaded the database. It is not uncommon for firms to file more than once, representing two observations. GVKEYs are provided for 1,138 observations. We exclude 25 observations that were filed as Chapter 7 bankruptcies and three observations that were immediately dismissed. Of the remaining 1,175 observations, all but one has data on whether the filing was pre-packaged, pre-negotiated, or free-fall. This subset of 1,174 observations is our primary sample.

Chapter 11 filings can be classified as free-fall, pre-negotiated, or pre-packaged. With pre-packaged filings, a reorganization plan has been voted on and accepted by creditors prior to the filing. With pre-negotiated filings, a reorganization plan has been sketched out and discussed with creditors, but no formal voting has occurred prior to filing. With free-fall filings, no reorganization plan exists prior to the filing. For all bankruptcy types, after filing, the firm continues to run its business operations, payments to bondholders are put on hold, and the firm stops any payments

to shareholders. Note, with a free-fall filing, the firm retains the greatest degree of operational flexibility during the protection period, as it is not bound by a pre-agreed reorganization plan.

Table 1 reports a variety of summary statistics reported for the full sample, subsamples of free-fall, pre-negotiated and pre-packaged filings, and subsamples of free-fall filings where the Lopucki database indicates that the firm announced an intention to sell all or substantially all assets as part of the bankruptcy process. Firms that file for free-fall, pre-negotiated, and pre-packaged bankruptcy differ substantially from one another. Therefore, much of our analysis will separately focus on the free-fall subsample.

There are 785 free-fall bankruptcies, 246 that are pre-negotiated, and 143 that are pre-packaged. The free-fall bankruptcies are more prevalent earlier in the sample period the average year in which a free-fall was filed is 2000. Pre-negotiated and pre-packaged are more prevalent later with average filing years of 2006 for both. For the free-fall observations, 37% are eventually liquidated and/or converted to Chapter 7, 17% are sold to or merge with another firm, and 46% survive and exit their Chapter 11 bankruptcy as independent firms. For pre-negotiated and pre-packaged, survival rates are much higher at 77% and 89% respectively. Conversely, merger rates and liquidation rates are substantially lower at 12% and 12% for pre-negotiated filings, and 7% and 5% for pre-packaged filings. For free-fall filings, 61% are shopped across potential court venues. Shopping is more prevalent for pre-negotiated and pre-packaged filings at 74% each. Slightly more than half of all filings occur in either Delaware or the Southern District of New York. Free-fall filings are the least likely to file in Delaware at 33% of total free-fall filings, followed by pre-negotiated at 40% and pre-packaged at 50%. For Southern District of New York filings, likelihoods are more similar at 18% for free-falls, 24% for pre-negotiated, and 19% for pre-packaged.

A key prediction of our model is that expectations of protection period duration affect firms decisions for whether to commit to sell assets when filing for bankruptcy. The UCLA-Florida-Lopucki Bankruptcy Research Database has a data field on whether a firm declares an intention to sell a substantial fraction of assets during bankruptcy.<sup>36</sup> For firms that filed for free-fall bankruptcy, 29% announce an intention to sell assets, versus 17% for pre-negotiated filings and 8% for pre-

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<sup>36</sup>Our model assumes that a firm has three options in bankruptcy. The first is to sell assets of one of its divisions. The second is to liquidate, meaning that assets of both divisions are sold at fire-sale prices. The third option is to wait and see whether the firm can independently recover without selling any assets. Reality is not nearly as tidy. Because the SaleIntended variable from the Lopucki Database reports an intention to sell all or substantially all assets, it is a proxy for the model's commitment to sell one of its two divisions.

packaged filings.<sup>37</sup> When splitting the free-fall sample into firms that announce an intention to sell assets and firms that do not, we see that 23% of those intending to sell emerge as independent firms. Conversely, 60% of those not announcing an intention to sell assets successfully reorganize. Note that firms are more likely to declare an intention to sell assets later in the sample period. This is one of the elements of the multi-faceted gradual shift in US bankruptcies that the model explains.

The next set of summary statistics in Table 1 are the actual number of days in bankruptcy until either the reorganization plan is accepted, the Chapter 11 case is converted to Chapter 7, or the case is dismissed. For firms that filed for free-fall bankruptcy during the prior two years, we calculate the average and median days in bankruptcy. This is done at a quarterly frequency for both the national and the court district levels. Each bankruptcy observation is matched to the corresponding prior quarter value. In our regression analysis, Duration Prior 2-yr and Duration Prior 2-yr (District) are proxies for the filing firms expectation of bankruptcy duration. As is predicted by our model, the longer is the expected duration of bankruptcy, the less pressure the filing firm will feel to commit to sell assets and conclude the reorganization process quickly. Instead, the filing firm is incentivized to file earlier to stop paying interest and to slow-walk the process, hoping that profitability will improve and reorganization will be feasible.

As was seen in Figure 1, free-fall bankruptcies have substantially greater mean and median days in bankruptcy than either pre-negotiated or pre-packaged bankruptcies. This is not surprising as a primary rationale for pre-negotiated and pre-packaged bankruptcies is to get in and out of bankruptcy quickly. For free-fall filings, the median time in bankruptcy is 530 days. For free-fall filings that occur in Delaware, the median duration is 419 days (not presented in tables). Median time in bankruptcy for free-fall filings occurring in the Southern District of New York and in the rest of the court districts of the United States are similar at 567 and 525 days respectively. We also observe that Duration Prior 2-yr and Duration Prior 2-yr (District) are greater for free-fall filings. This reflects a general time trend of bankruptcy duration becoming shorter later in the sample period and pre-negotiated and pre-packaged bankruptcies increasing in prevalence over time. Firms that filed for free-fall bankruptcy and that also announced an intention to sell assets

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<sup>37</sup>In the model a commitment to sell assets is a binding commitment. However, approximately 27% of firms announcing an intention to sell all or substantially all assets don't appear to follow through on that intention. The disaggregated figures for free-falls, pre-negotiated and pre-packaged filings are 28%, 21%, and 33%, respectively.

spend significantly less time in bankruptcy than free-fall filers that do not announce an intention to sell assets. Consistent with being more common later in the sample period, the subset of firms that announced an intention to sell assets have lower Duration Prior 2-yr and Duration Prior 2-yr (District)

The third block of data in Table 1 presents calculated Z-scores of the firms filing for bankruptcy. These calculations use Compustat data. Altman (1968) introduced Z-score as a predictive measure of corporate default. Subsequently, Z-score has become a heavily used proxy in the academic literature for financial distress. Altman (2000) introduces Z'-score and Z''-score. The primary difference with the two later measures is that the book value of equity is substituted for market value of equity. Thus, Z'-score and Z''-score can be calculated for non-publicly traded firms. Table 1 reports all three measures of Z-score, calculated using data from the fiscal year ending nearest to the bankruptcy declaration (and no more than three years earlier). All three measures of Z-score are greater for free-fall bankruptcies. Higher Z-scores mean more financially healthy firms. Thus, firms that file for free-fall bankruptcies do so earlier and are less distressed than those that file for either pre-negotiated or pre-packaged bankruptcies. When separating firms that filed for free-fall bankruptcy into those that either did or did not announce an intention to sell assets, the differences in the three measures of Z-score are not significantly different from one another.

In the fourth block of Table 1 we have a mix of Compustat and UCLA-Florida-Lopucki derived data items. Firms that file for free-fall bankruptcy are less likely to be incorporated in Delaware (68%) than are either pre-negotiated (80%) or pre-packaged filers (74%). Consistent with having better Z-scores, firms that file for free-fall bankruptcy have lower leverage and slightly better (less negative) ROA. A proxy for Tobins Q is similar across the three groups. Firms that file for free-fall bankruptcy have greater average total assets than the other two groups, but median values are approximately the same. Free-fall filers do, however, seem to have more employees than the other two groups. The biggest difference for the two subsets of free-fall filing firms is that those that announced an intention to sell assets are approximately one-half the size of those not announcing such an intention. Other characteristics are relatively similar. Given the cross-sectional differences evident in the summary statistics, we control for many of these variables in our regression analysis.

The last block of data in Table 1 reports the change in total assets and employees between the latest pre-filing fiscal year and earliest post-filing fiscal year as reported in the Lopucki data. From Compustat, we calculate the change in net PP&E. Note that these measures of changes are

only available for firms that emerge as independent companies after bankruptcy and which file a 10k with the SEC. Because accounting write-downs also affect total assets, and to a lesser extent net PP&E, these pre- and post- differences are proxies for the fraction of assets sold during the bankruptcy process. While the change in employees is not subject to write-downs, firms can lay off employees without selling assets. Thus, change in employees is also a proxy for the fraction of assets sold. We see that for all three measures change in total assets, change in net PP&E, and change in employees, there is a greater change for firms that filed for free-fall bankruptcy. Amongst free-fall filers, there is a greater change in net PP&E for those that announce an intention to sell assets, indicating that they are more likely to engage in asset sales during bankruptcy.

### **4.3 Regression Analysis**

#### **4.3.1 Financial Condition Prior to Bankruptcy Filing**

Prediction 1 of our model is that firms will file for bankruptcy earlier, at lesser stages of financial distress, when they expect that the duration of bankruptcy allowed by the court will be longer. This reflects that bankruptcy protection provides a valuable option for the firm where it is free from creditor demands and can shelter while working to improve profitability. The longer is the expected bankruptcy protection, the more valuable is this option. Thus, the firm exercises this option earlier at a lesser stage of financial distress.

As previously noted, we use the time required to conclude prior free-fall bankruptcies as a proxy for this expectation. In all subsequent tables, the median of Duration Prior 2-yr is called Expected Duration. Table 2 Panel A presents results of OLS regressions where the dependent variable is one of the three different measures of Z-score. In the odd-numbered specifications we have dummy variables denoting whether the filer is a financial institution or a regulated utility. In the-even numbered specifications we replace those dummies with Fama-French 12-digit industry fixed-effects. Pre-packaged filings are the base group in the analysis. In all regressions henceforth, we report heteroscedasticity robust t-statistics that have been clustered by gvkey.

We observe that coefficient estimates for Expected Duration are positive and statistically significant at the 5% level or better for all specifications, except for the second and fifth specifications where statistical significance is at the 10% level. Thus, consistent with Prediction 1, firms choose to



file earlier the longer is the ex-ante expected time in bankruptcy.<sup>38</sup> Coefficient estimates are larger and with greater statistical significance when Z-score and Z-score are the dependent variables.<sup>39</sup> Results are similar with both sets of industry controls.

Consistent with our univariate statistics, we also observe that coefficient estimates for the free-fall dummy variable are always positive and, for five of the six specifications, statistically significant at the 5% level (the fourth is significant at the 10% level). For the pre-negotiated filings dummy, coefficient estimates are substantially smaller, and never significantly different from zero. Differences in these coefficient estimates are statistically significant (not presented in tables).<sup>40</sup> While our model does not distinguish between free-fall, pre-negotiated, and pre-packaged bankruptcy filings, it is consistent with the spirit of our model that firms filing for free-fall bankruptcy have better Z-scores. As noted previously, this is because firms filing for free-fall bankruptcy are less constrained by any pre-existing reorganization plans. Thus, there is greater option value associated with filing for bankruptcy and filings occur earlier. Conversely, firms that choose to file pre-negotiated or pre-packaged bankruptcy should wait longer and have worse Z-scores when they file, precisely as we find in our regression analysis.

In three of the six specifications, coefficient estimates for Firm Age are positive and statistically significant. Thus, there is some evidence that older firms file for bankruptcy at deeper stages of distress. For  $\text{Ln}(\text{Assets})$ , coefficient estimates flip between negative and positive depending on whether we use Bank and Utility as industry controls or Fama French 13 industry fixed effects. Note that bankruptcies filed in Delaware, and to a lesser extent those filed in the New York Southern District, are resolved more rapidly than those filed elsewhere (results not presented in tables). However, dummy variables for these two filing locations have no explanatory power in the Z-score

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<sup>38</sup>If we use median Duration Prior 2-yr (District) in place of the national level variable, results are quite similar (not presented in tables). If Expected Duration is replaced with a dummy variable for whether the filing occurred before (0) or after (1) passage of the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA) then coefficient estimates for BAPCPA consistently show the same relationship of Expected Duration to our various dependent variables.

<sup>39</sup>Regression results are strongest with Z-score'. This formulation of Z-score has the lowest standard deviation of the three Z-score measures. Also note that the regression R-square is substantially greater when Z-score' is utilized. Because of these better characteristics, we rely on Z-score' in later regressions where Z-score is an independent variable. If the Z-score measures are replaced with interest coverage, calculated as either EBITDA/Interest Expense or EBIT/Interest Expense, as the dependent variable, coefficient estimates for Expected Duration are still positive and statistically significant. However, R-Squared values are quite low, reflecting that interest coverage is a noisy measure of financial health.

<sup>40</sup>In contrast, Chatterjee, Dhillon, and Ramirez (1996) and Yost (2002) both find that firms that file for free-fall bankruptcy are generally in worse financial condition than those that file for a pre-packaged bankruptcy.

regressions. Similarly, a dummy variable for whether the firm is headquartered in Delaware has no explanatory power.<sup>41</sup>

In Table 2 Panel B, we limit the sample exclusively to firms that filed for free-fall bankruptcy and eliminate the two filing type dummy variables. Coefficient estimates for Expected Duration are similar in both magnitude and statistical significance to the full-sample results. Again, consistent with Prediction 1, firms choose to file earlier when prior free-fall bankruptcy filings in the recent past have taken a longer time to be concluded. Note that coefficient estimates for Ln(Assets) flip between positive and negative in the full sample estimations in Panel A depending on what industry control we use. In Panel B, coefficient estimates for Ln(Assets) are negative in all specifications, and statistically significant when Bank and Utility are the only two industry controls. Thus, there is some evidence that bigger firms and older firms file for bankruptcy later, at worse financial health.<sup>42</sup> Perhaps this reflects better access to financing for these firms or more liquid markets for their assets. Finally, utility firms have worse Z-scores when they file for bankruptcy. This may reflect that many utilities have rates that are set by regulators and that they can rely on some degree of regulatory rate relief when in financial distress.

### 4.3.2 Announcing an Intention to Sell Assets Prior to Filing for Bankruptcy

Prediction 2 of our model is that firms will be less likely to commit to sell assets when filing for bankruptcy the longer is the expected time in bankruptcy. Note that in the model, a commitment to sell assets is binding. In the real world, however, firms are announcing an intention to sell assets, not a commitment. For firms that filed for free-fall bankruptcy and did (did not) indicate an intention to sell assets, 72% (47%) actually do sell a significant fraction of assets. For firms filing for pre-negotiated and for pre-packaged bankruptcies, those percentages are 67% (26%) and 79% (35%). Thus, our Sale Intended variable is a proxy for what the model envisions.

In Table 3, we analyze if expected bankruptcy duration has an impact on whether firms announce an intention to sell assets during the bankruptcy process. For the full sample as well as

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<sup>41</sup>These control variables are included in all regressions for consistency. They each have statistically significant coefficient estimates in at least one regression.

<sup>42</sup>Firm size is a common control variable in empirical bankruptcy studies. Franks and Torous (1994), and Betker (1995), for example, document that deviations from the absolute priority rule are more common and of greater magnitude in bankruptcies of larger firms. Dennis and Rogers (2007) find that smaller firms spend less time in bankruptcy while Iverson (2018) finds that post-BAPCA, larger firms that file in courts with a greater decline in caseload are less likely to successfully restructure.

the subsample of exclusively free-fall filings, there is a strong negative relationship between Expected Duration and the announced intention to sell assets.<sup>43</sup> Consistent with Prediction 2, when firms anticipate a longer bankruptcy duration, they seem to take a wait-and-see approach during bankruptcy and are less likely to announce an intention to sell assets prior to filing. As with the Z-score results, this is because with longer expected duration, there is greater option value for the firm associated with retaining flexibility by not committing to shed assets and potentially exiting as a larger firm if business conditions improve. Note that coefficient estimates for Free-Fall and Pre-Negotiated are positive and statistically significant at the 1% level. Thus, consistent with our summary statistics, firms that file for free-fall bankruptcy and for pre-negotiated bankruptcy are more likely than pre-packaged filing firms to announce an intention to sell assets prior to filing.

For other control variables, we observe in the full sample regressions that firms filing for bankruptcy in Delaware are more likely to announce an intention to sell assets. This is consistent with the observation that bankruptcies filed in Delaware generally wrap up more quickly and that shorter protection periods create a stronger incentive to commit to sell assets. However, coefficient estimates for DE filed are not statistically significant in the free-fall only regressions. Older firms are less likely to announce an intention to sell assets. There is weak evidence that larger firms and firms that file in the Southern District of New York are less likely to announce an intention to sell assets. Finally, financial service firms are weakly more likely to announce an intention to sell assets, perhaps because some financial firms (e.g., banks) are regulated and need to sell assets to rebuild capital to a required level.

Prediction 3 of our model is that firms that file with a commitment to sell assets will do so at deeper stages of financial distress. However, coefficient estimates for Z-score' (or any other financial health variable) are not significantly different from zero. This may be asking too much of our data as the Sale Intended dependent variable is a rough proxy for the models commitment to sell assets. We have also tested whether shopping the filing across various courts and whether M&A activity such as industry waves (Mitchell and Mulherin (1996), Mulherin and Boone (2000), Harford (2005)) or private buying pressure (Eckbo, Makaew, and Thornburn (2018)) impact the likelihood of declaring an intention to sell assets. However, we find no significant effects for these

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<sup>43</sup>Free-fall filings are a cleaner test for the impact of expected time in bankruptcy on the likelihood of substantial asset sales as none of the filing firms have reached a consensus on reorganization with creditors prior to filing. A lack of consensus is more likely when substantial changes to the firm's operating assets (not just mix of liabilities) will be needed for successful reorganization.

factors

### **4.3.3 Actual Sales of Assets During Bankruptcy**

Prediction 4 from our model is that for firms filing for bankruptcy without committing to sell assets, the probability of asset sales during the protection period declines as the expected duration of the bankruptcy period lengthens. In Table 4, our dependent variable is a dummy variable indicating actual sales of assets during the bankruptcy process. These sales can either be Section 363 sales of substantially all of the debtors assets or sales that are pursuant to the confirmed plan. In the first specification we use the full sample and include Sale Intended as an independent variable. In the second, we limit the sample to the subset of firms that did not state an intention to sell assets prior to or at the filing for bankruptcy. In the third, we again include Sale Intended as an independent variable, but limit the sample to only free-fall filings. Finally, in specification four we limit the sample to free-fall filings where the firm did not state an intention to sell assets. Consistent with Prediction 4, we find a strong negative relationship between Expected Duration and actual sales of assets. Coefficient estimates in all four specifications are statistically significant at the 1% level. Thus, with a longer expected bankruptcy duration, firms find greater option value in slow-walking the bankruptcy process, not selling assets, and hoping for improvements in business conditions.

As would be expected, there is a strong positive relationship between an announced intention to sell assets and actual asset sales. Consistent with our summary statistics and results in Table 3, free-fall filings and pre-negotiated filings are more likely to actually sell assets as part of the reorganization. As with intention to sell, there is a slightly greater propensity to sell assets when the bankruptcy filing occurs in Delaware. Again, this is consistent with the fact that bankruptcies filed in Delaware generally conclude more quickly. Coefficient estimates for characteristics of the filing firm, such as firm size, age, or Z-score' are not statistically significant. We have also tested whether industry M&A or private buying pressure in the market affects assets sales (results not presented in tables) and we find no measurable impact.

#### 4.3.4 Choice between Free-Fall, Pre-Negotiated or Pre-Packaged Bankruptcy

Whether a firm negotiates with creditors ahead of filing for bankruptcy and the type of agreements it reaches are affected by numerous conditions that are outside the scope of our model.<sup>44</sup> Nevertheless, it is clear that firms retain the greatest flexibility in how they manage the bankruptcy process if they choose a free-fall filing rather than a pre-negotiated or especially a pre-packaged filing. While real-world filing type choice differs from our models choice of whether to commit to asset sales prior to filing, the contrast between more and less flexible bankruptcy processes is similar. Such flexibility should be more valuable for the firm when the protection period is expected to be longer.

Summary statistics clearly show that free-fall filings are more prevalent earlier in the sample period when bankruptcy durations are longer. In Table 5 we test this relationship using a multinomial logit and an ordinal logit model where free-fall is the base case (0), followed by pre-negotiated (1), and by pre-packaged (2). This reflects their natural ordering from the least restrictive to the most restrictive bankruptcy method. Consistent with the pattern observed with the summary statistics, the multinomial logit regression reported in the first two columns shows that firms are less likely to choose pre-negotiated and pre-packaged filings when the expected protection period is longer. Note that the coefficient estimate in the pre-packaged column is larger in magnitude than the one for pre-negotiated. This is consistent with our ordinal logit regression in the last column where the coefficient estimate for Expected Duration is negative, highly statistically significant, and in between the estimates reported in the first two columns for the multinomial regression. Thus, when the protection period is expected to be longer, the flexibility of a free-fall filing makes it a more favorable bankruptcy method for the firm than either pre-negotiated or pre-packaged bankruptcy.

We have also estimated ordinal logistic regressions where we have coded observations from zero to five where zero is free-fall with no announced intention to sell assets, one is free-fall with an announced intention to sell assets, two is pre-negotiated with no announced intention to sell assets, etc. This ordering captures the degree of flexibility of the firm entering bankruptcy. Unfortunately, a Chi-square test for the assumption of proportional odds is statistically significant, indicating that the regression is poorly specified. With that caveat in mind, we find that the coefficient estimate for Expected Duration is negative and highly statistically significant (results not presented in tables). This lends additional support to the model's idea that when the expected bankruptcy duration is

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<sup>44</sup>For example, see Demiroglu and James (2015), Ivashina, Iverson and Smith (2015), or Lim (2015).

longer, firms are less willing to pre-negotiate or accept any pre-packaged resolutions. Instead, they are more likely to enter bankruptcy without any plan, hoping for favorable market outcomes during the protection period.

Consistent with Z-score regressions in Table 2, negative coefficient estimates for Z-score' in Table 5 show that firms that file for free-fall bankruptcy do so earlier and are in better financial health when compared to firms that file for pre-negotiated and pre-packaged bankruptcies. We also observe that firms that file in Delaware and in the Southern District of New York are more likely to choose pre-negotiated and pre-packaged bankruptcy filings. Finally, we see evidence that older firms are less likely to file for pre-packaged bankruptcy.

#### 4.3.5 Liquidation or Survival of Bankrupt Firms

Prediction 5 from our model is that there is a greater probability of eventual liquidation when the firm enters bankruptcy with no commitment to sell assets. In addition, the liquidation probability increases with the expected duration of bankruptcy. Unfortunately, our data does not allow for a direct test of the first half of the prediction. This is because Sale Intended in the Florida-UCLA-Lopucki database is an announced intention to sell all or substantially all assets as part of the bankruptcy process. By definition, if a firm follows through on this intention, it often leads to either liquidation or a merger or acquisition by another firm and the firm does not emerge from bankruptcy as a going concern. This does not conform to the mechanics of our model where a commitment to sell is solely for Division 2. In addition, the model does not envision merger or acquisition of the entire firm as an exit method.

With those two caveats in mind, in Tables 6a and 6b we analyze how bankruptcies in our sample are resolved. In our sample, firms either liquidate and/or convert to Chapter 7 bankruptcies, merge with or are acquired by another firm, or survive and emerge from bankruptcy as independent firms. In Table 6a we present coefficient estimates from multinomial logit regressions where surviving as an independent firm is the base case. Coefficient estimates are the log-odds of observing liquidation relative to emerging independently and of observing merger and/or acquisition relative to emerging independently.<sup>45</sup>

The first two specifications in Table 6a utilize the entire sample, while the second two utilize

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<sup>45</sup>To conserve space, we do not report the results where we utilize Fama-French 12-digit industry controls. However, these results are very similar to those when using dummy variables for financial institutions and for regulated utilities.

the free-fall only subsample. As is expected, coefficient estimates for Sale Intended are positive and statistically significant at the 1% level in all four specifications. Thus, surviving as an independent firm is less likely (relative to merger and to liquidation) when Sale Intended equals one. Controlling for Sale Intended, we find that coefficient estimates for Expected Duration are positive and statistically significant at the 1% level when comparing both liquidation to survive and merger/acquisition to survive. The signs of the coefficient estimates for Expected Duration are consistent with the second half of Prediction 5 which is that liquidation (i.e. not surviving as an independent firm) increases with the expected duration of bankruptcy. This is the end result of delayed disinvestment and firms resisting selling assets to pay down debt. While this delay increases option value for shareholders, the firm crashes and burns more often.

Coefficient estimates for the Free-Fall dummy variable are consistently positive and statistically significant for both liquidation and merger relative to survival in the full sample regressions. Thus, while firms that file for free-fall bankruptcy enter with better Z-scores, they are the least likely to survive and emerge as independent firms. Amongst the other control variables, we find that bankruptcies that were filed in Delaware are more likely to result in a merger or acquisition and those filed in the Southern District of New York are less likely to result in liquidation. We also find that larger firms and more financially healthy firms are less likely to merge relative to survive and that older firms are moderately less likely to be liquidated relative to survive.<sup>46</sup> Finally, financial institutions are significantly more likely to be liquidated. This could be because of pressure from regulators. Results for the free-fall only subsample mirror those for the full sample.

In Table 6b, we estimate the same set of specifications using binomial logistic regressions. For one set of specifications the dependent variable is Survive, which is coded 1 for firms that successfully exit Chapter 11 as independent companies and zero for firms that are either liquidated or are merged/acquired by another firm. In the second set of specifications, our dependent variable is Liquidated, which is coded 1 for firms that are liquidated, and zero for firms that exit as independent companies or which are merged/acquired by another firm. In each case, mergers are included in the zero set. When Survive is the dependent variable, the Expected Duration coefficient estimate is negative and statistically significant at the 1% level in all four specifications. Conversely, when Liquidated is the dependent variable, coefficient estimates for Expected Duration are positive and

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<sup>46</sup>Hotchkiss (1995) finds that larger companies are more likely to emerge from bankruptcy as public companies.

statistically significant at the 1% level. As with the multinomial logit regressions presented in Table 6a, the binomial regression results in Table 6b indicate that bankruptcies are more likely to terminate with liquidation the longer is expected bankruptcy duration. Free-fall filings are less likely to result in survival, and more likely to result in liquidation. Coefficient estimates for pre-negotiated are not significantly different from zero. Bankruptcies that are filed in Delaware and in the Southern District of New York are more likely to survive and less likely to be liquidated. While it seems surprising at first glance that firms with better pre-bankruptcy Z-score' values are more likely to be liquidated, this is consistent with the net result of Predictions 3 and 5 of our model. As with the regressions in Table 6a, banks are less likely to survive and more likely to be liquidated.

#### **4.3.6 Change in Net PP&E and Number of Employees after Bankruptcy**

In this section we analyze changes in firm size for the subset of firms that emerge from bankruptcy as independent firms and file audited financial statements within three years of the confirmation date. Note that our model assumes that firms that declare bankruptcy can either sell 50% of their assets (Division 2) or gamble that business conditions will improve and that the firm can emerge from bankruptcy with the same size as when they entered. Some firms that gamble will get lucky and survive. A larger fraction of firms that decide to sell Division 2 will survive and they will exit bankruptcy as smaller firms. Deciding to sell assets is more likely with shorter expected bankruptcy duration. Conversely, gambling on redemption is more likely with longer expected bankruptcy duration. Empirically, our model suggests that, contingent on survival, there will be a positive relationship between expected bankruptcy duration and post-bankruptcy firm size.

For our analysis of changes in firm size, our two dependent variables are Percent Change in Net PP&E and Percent Change in Employees. These two variables are chosen, rather than percent change in assets as they are cleaner measures of the extent to which a firm has reduced its scale during bankruptcy. For percent change in assets, changes are relatively more likely to be attributable to write-downs of inventories, goodwill and intangibles, factoring of accounts receivable, etc. The two continuous measures provide an alternative to our binomial regressions in Table 4 for assessing the degree to which a bankrupt firm downsizes in order to exit bankruptcy. Because observing either dependent variable is contingent on the firm surviving, we estimate two-stage regressions



where the first stage uses the variables from Table 6 that predict whether a firm will survive.<sup>47</sup>

Coefficient estimates for Expected Duration provide an interesting contrast to the results presented in Table 4. In the regressions in Table 7, second stage coefficient estimates for Expected Duration are negative and statistically significant at the 5% level or better for both dependent variables. This result holds for the full sample and the subset of free-fall filings. Thus, while we earlier found that firms are less likely to sell assets the longer is the expected time in bankruptcy, Table 7 shows that for those firms that survive, they decrease in size by more the longer is the expected time in bankruptcy. Note that when including the Sale Intended dummy variable in the second stage regression, its coefficient estimates are not statistically significantly different from zero (results not presented in tables). We also find that larger firms as well as financial institutions decrease in size by more during bankruptcy.

## 5 Conclusion and Future Research

We provide a theoretical model of the Chapter 11 bankruptcy process where the firm decides when to file, whether to commit to sell assets, and whether to actually sell assets while in bankruptcy. These decisions are impacted by two primary exogenous factors – the anticipated length of the bankruptcy protection, and the price at which the firm will be able to sell assets. With these two basic inputs and three decisions, the model produces a variety of predictions that offer new insights into the Chapter 11 bankruptcy process.

Our empirical analysis primarily focuses on changes in the anticipated length of corporate bankruptcies. Our results for large corporate bankruptcies that were filed between 1980 and 2021 largely support the predictions of our model. We find that when firms anticipate a longer bankruptcy period, they file earlier, before they are in deep financial distress. Firms are also less likely to pre-announce an intention to sell assets during bankruptcy, and are less likely to actually sell assets during bankruptcy. The disinclination to sell assets in a timely manner and exit bankruptcy as a smaller firm means that a greater proportion of bankrupt firms fail and are liquidated when the anticipated bankruptcy protection period is longer. In attempting to maximize equity value, firms are gambling that they can exit bankruptcy as a result of improved business conditions, with-

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<sup>47</sup>The actual variables used in the first stage are Prior 2-yr Duration, Sale Intended, Free-Fall, Pre-Negotiated, Ln(Assets), Age, Delaware, Delaware-Filed, NYSD-Filed, and controls for industry.

out having to reduce the size and scope of the firm. As a result, ex-ante firm value is negatively impacted by greater expected bankruptcy costs.

This is a significant inefficiency that appropriate bankruptcy design can minimize. The policy implication of our model is that limiting the duration of Chapter 11 bankruptcy leads to overall welfare improvement. The Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) of 2005 imposed an 18-month limit on the exclusivity period where the firm is the only entity that can propose a reorganization plan. While perhaps under-appreciated at the time, this was an important step in improving the efficiency of Chapter 11 as it improved the incentives for financially distressed firms.

The model and the empirical approach can be extended along several dimensions. One extension would be to analyze the role of uncertainty about the prices the bankrupt firm might receive for assets that it offers up for sale. Alternatively, one could explore the effects of institutional ambiguity regarding what type of judge will be assigned to the bankruptcy case – a hands-on judge that forces the firm to sell assets and is not inclined to grant extensions to the exclusivity period, or a hands-off judge that has a more lenient approach. We leave these possible extensions for future research.

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## Appendix A:

**Proof of Proposition:** if the equity value with the option to sell assets is higher than the equity value with the option to liquidate, then,  $([-(1-\lambda) \cdot (p_s/\alpha - (c+d))/r] + E_1(p_s, d_1)) \cdot (1/p_s)^{\beta_2} > [-(1-\lambda) \cdot (p_{ns}/\alpha - c/r - d/r) \cdot (1/p_{ns})^{\beta_2}]$ . If  $p_s > p_{ns}$ , then,  $E_1(p_s, d_1) > 0$ , which implies  $p_{d1} < p_s$ . Hence,  $p_{ns} < p_{d1}$ . Otherwise, the above equation cannot hold. A different way to prove is the following: If  $p_{ns} > p_{d1}$ , then at  $p_{ns}$ ,  $E_1(p_{ns}, d_1) > E_0^{ns}(p_{ns}) = (1-\lambda) \cdot [(p_{ns}/\alpha - c/r - d/r) - (p_{ns}/\alpha - c/r - d/r) \cdot (p_{ns}/p_{ns})^{\beta_2}] = 0$ . Then,  $(1-\lambda) \cdot [Q_1 \cdot p_{ns}/\alpha - c_1/r - d_1/r] - (Q_1 \cdot p_{d1}/\alpha - c_1/r - d_1/r) \cdot (p_{ns}/p_{d1})^{\beta_2} > 0$ , and hence at  $p_{ns}$  the following has to hold:  $[Q_1 \cdot p_{ns}/\alpha - c_1/r - d_1/r] - (Q_1 \cdot p_{d1}/\alpha - c_1/r - d_1/r) \cdot (p_{ns}/p_{d1})^{\beta_2} > 0$ , which implies that  $p_{ns} > p_{d1}$ . At the debt payment for which  $p_{ns} = p_{d1}$ , the shareholders are indifferent between liquidating the firm or executing the asset sales.

From these equations, the critical sale price,  $S^*$ , has to satisfy  $S^* = \frac{c_1 + d - (c+d)Q_1}{r}$ .<sup>48</sup> In other words, if the sale price for Division 2 exceeds  $S^*$ , the option to sell assets leads to higher equity value than the option to liquidate the firm. Otherwise, if debt outstanding is  $S < S^*$ , then shareholders liquidate the firm without selling assets of Division 2.

### Firm Valuation for Bankruptcy with the commitment to sell assets

The valuation of debt and equity is similar to that for the Chapter 11 with no commitment, but needs to be slightly adjusted to incorporate that the firm is committed to asset sales by the end of the protection period. At  $t = T$ :

$$E(p, N, U, T) = \max \begin{cases} E_1(p, d_1) + N(T) - U(T), & \text{The firm sells assets, and emerges with less debt} \\ & \text{and capacity } Q_1 \text{ at } t = T. \\ 0, & \text{The firm sells assets, and} \\ & \text{then it liquidates at } t = T. \end{cases} \quad (29)$$

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<sup>48</sup>If Chapter 11 is not possible, the other way to preempt liquidation is to renegotiate that the firm sells assets at the product price above  $p_s$  but let it pay out some of the sale proceeds to equityholders. This would be a forbearance (a violation) of the debt covenant. If such forbearance is optimally designed, it can potentially enhance firm value by incentivizing the firm to sell assets earlier before entering a deep distress stage. Another alternative to incentivize the firm to sell assets is to have debtholders accept a partial write-down of debt. The model can handle these extensions too, but the renegotiation of debt covenants or debt forgiveness is outside the main focus of this paper.

$$D(p, N, U, T) = \begin{cases} D_1(p, d_1) + U(T) + S, & \text{if the firm sells assets and emerges} \\ & \text{as going concern with less debt and capacity of } Q_1. \\ S + (1 - DC)V_{Uq}(p) + N(T), & \text{if } E(p, N, U, T) = 0, \text{ and} \\ & \text{the firm sells assets and liquidated at } t = T, \text{ and} \\ & \text{the debtholders recover the fraction of the firm.} \end{cases} \quad (30)$$

where  $V_{Uq}(p)$  is the value of the unlevered firm after asset sales as described earlier.

For any time  $t$ ,  $0 \leq t < T$ , we solve for free boundary conditions that reflect firm's sale/no sale decision. In the *no action region*, the value of the equity is given by the same PDE as in 24.

The shareholders optimally choose to sell assets if the net benefit of sales and subsequent emergence from the bankruptcy exceeds the equity value when the firm continues to operate under the protection period. The equity values in these regions can be determined by the following:

$$E(p, N, U, t) = \max \begin{cases} e^{-rdt} \mathbb{E}^Q \{E(p, N, U, t + dt)\}, & \text{firms continues} \\ & \text{to operate under the protection period} \\ E_1(p, d_1) + N(t) - U(t), & \text{the firm sells assets and} \\ & \text{emerges with less debt and smaller capacity.} \end{cases} \quad (31)$$

Now, we evaluate the firm before it files for bankruptcy with a commitment. The revenue  $p_{comm}$  is an optimal entry point. By assumption, when the firm files for Chapter 11, it pays a one-time filing and administrative fee,  $c_{comm}$ . The equity value at revenue  $p$  is the following:

$$E_{comm}(p, d) = (1 - \lambda) \cdot (p/\alpha - (c_1 + c_2 + d)/r) - [(1 - \lambda) \cdot (p_{comm}/\alpha - (c_1 + c_2 + d_1)/r)] \quad (32)$$

$$-E(p_{comm}, 0, 0, 0) + Cp_{comm}] \cdot (p/p_{comm})^{\beta_2}, \quad p > p_{comm}. \quad (33)$$

At the optimal entry,  $p_{comm}$ , the value of the equity has to satisfy the smooth pasting and value maximization conditions similar to those for the no-commitment bankruptcy described earlier. The debt value is

$$D_{comm}(p, d) = d/r - [d/r - D_2(p_{comm}, 0, 0, 0)] \cdot (p/p_{comm})^{\beta_2}, \quad p > p_{comm}. \quad (34)$$

At  $p = p_{comm}$ , the debt value:

$$D_{comm}(p, d) = D_2(p_{comm}, 0, 0, 0). \quad (35)$$

## Appendix B: Variable: Definition

Declare Year:	Calendar year when bankruptcy filing occurred.
Liquidated:	Lopucki emerge = “no” and any of nameemerging, firmend, or ceonotes contains “liquidat” or ceonotes contains “Chapter 7” or disposition contains “converted”.
Merger:	Liquidated = 0 and Lopucki date10kemerging is missing and afteremerging contains “Acquired by”, “merged”, or “sold to” or firmend contains “merged” or “merger”.
Survived:	Liquidated = 0 and Merger = 0.
Shopped:	Lopucki shop field = “Yes”.
Sale Intended:	Lopucki saleintended field = “Yes” or “Invest” or “maybe”.
Asset Sales:	Lopucki sale363=”Yes” or saleconf=”Yes”.
Actual Days In:	Number of days from filing date to confirmation date, conversion to Chapter 7 date, or dismissal date.
Prior 2-yr Duration :	Sample-wide Days In for free-fall filings over the previous two years.
Prior 2-yr Duration (District):	Judicial district Days In for free-fall filings over the previous two years.
Z-score:	$1.2*((\text{current assets}-\text{current liabilities})/\text{total assets}) + .6*(\text{retained earnings}/\text{total assets}) + 3.3*(\text{EBIT}/\text{total assets}) + 1.4*(\text{market cap}/\text{total liabilities}) + .999*(\text{sales}/\text{total assets}).$
Z-score’:	$0.717*((\text{current assets}-\text{current liabilities})/\text{total assets}) + 0.847*(\text{retained earnings}/\text{total assets}) + 3.107*(\text{EBIT}/\text{total assets}) + 0.420*(\text{book equity}/\text{total liabilities}) + 0.998*(\text{sale}/\text{total as-sets}).$
Z-score”:	$6.56*((\text{current assets}-\text{current liabilities})/\text{total assets}) + 3.26*(\text{retained earnings}/\text{total assets}) + 6.72*(\text{EBIT}/\text{total assets}) + 1.05*(\text{book equity}/\text{total liabilities}).$
Delaware HQ:	Firm is incorporated in state of Delaware.
ROA_COMP:	Compustat: net income/total assets.
ROA_Lopucki:	Lopucki: net income/total assets.
Q:	$(\text{total assets} - \text{book equity} + \text{market cap} - \text{deferred income tax})/\text{total assets}.$
Assets_Comp:	Compustat: total assets from last financial statements prior to filing.
Assets_Lopucki:	Lopucki: total assets from last financial statements prior to filing.
Employees_Lopucki:	Lopucki: total employees from last financial statements prior to filing.
Pct Asset Chg:	Lopucki: percentage change in total assets from last financial statement prior to filing to first statement after emerging.

Pct Net PP&E Chg: Compustat: percentage change in Net PP&E from last financial statement prior to filing to first statement after emerging.

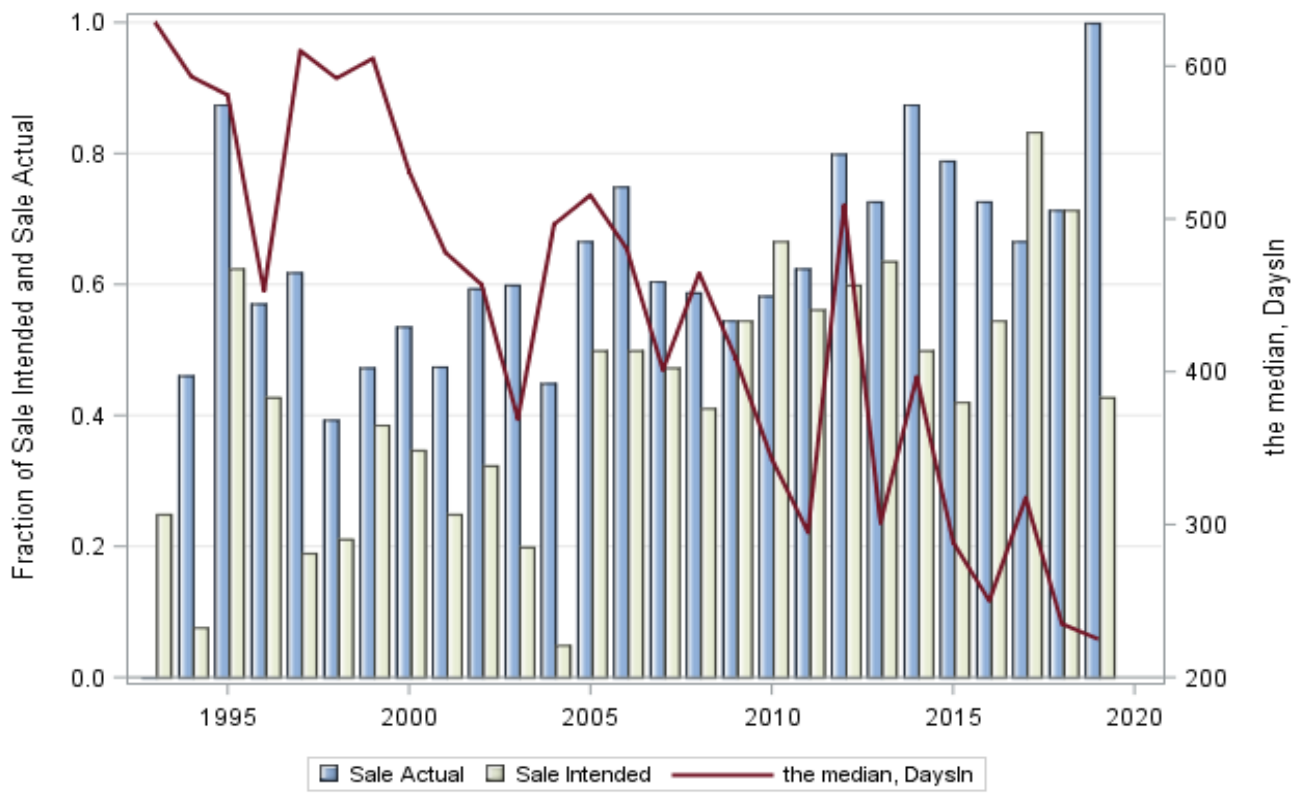
Pct Empl Chg: Lopucki: percentage change in total employees from last financial statement prior to filing to first statement after emerging.

Delaware Filed: Bankruptcy filed in the state of Delaware.

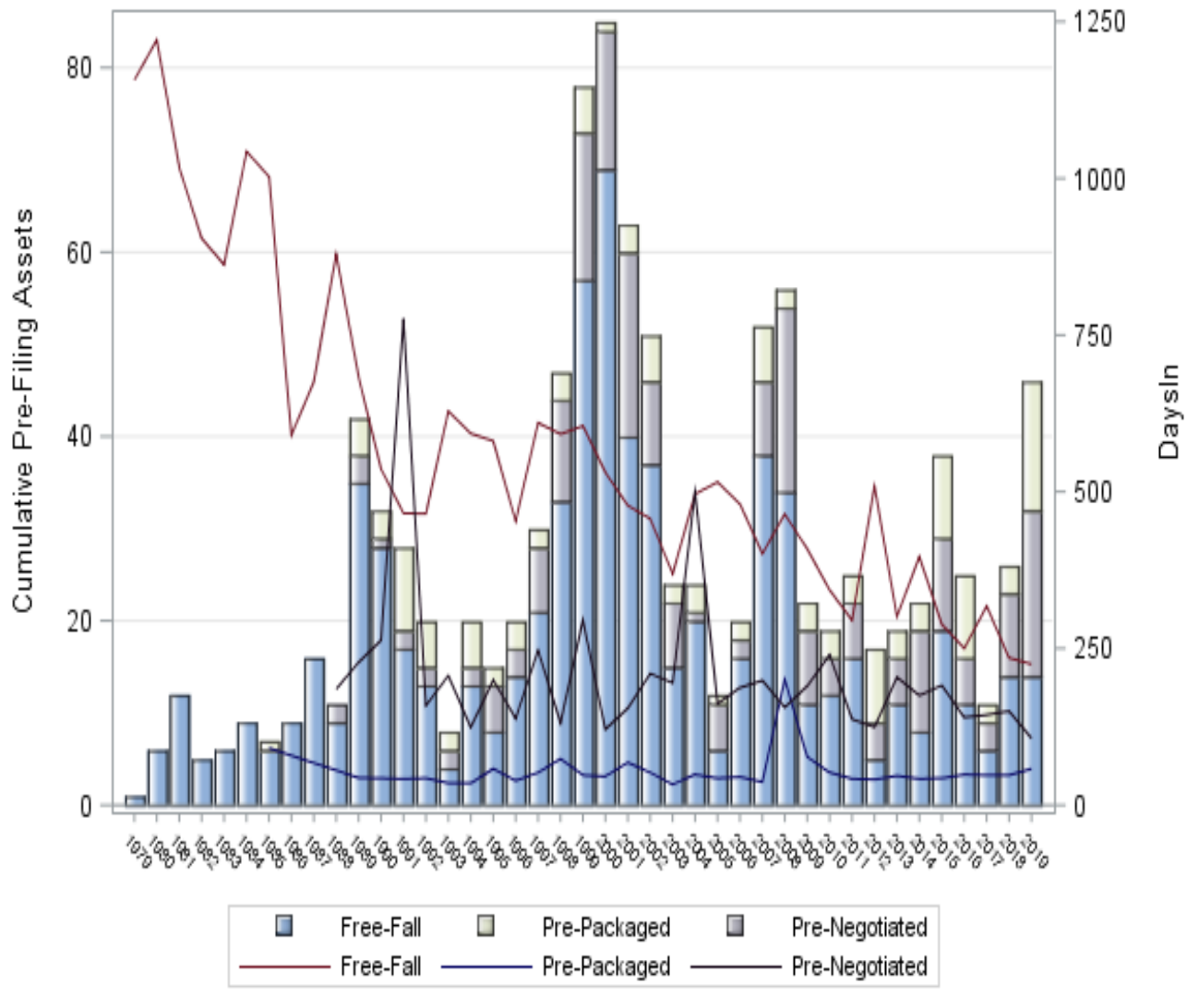
NYSD Filed: Bankruptcy filed in the Southern District of New York.

Firm Age: Compustat: establishment date – filing date.

**Figure 1: Fraction of Sale-Intended and Sale Actual and Median Days Spent in Bankruptcy (both series are for free-falls)**



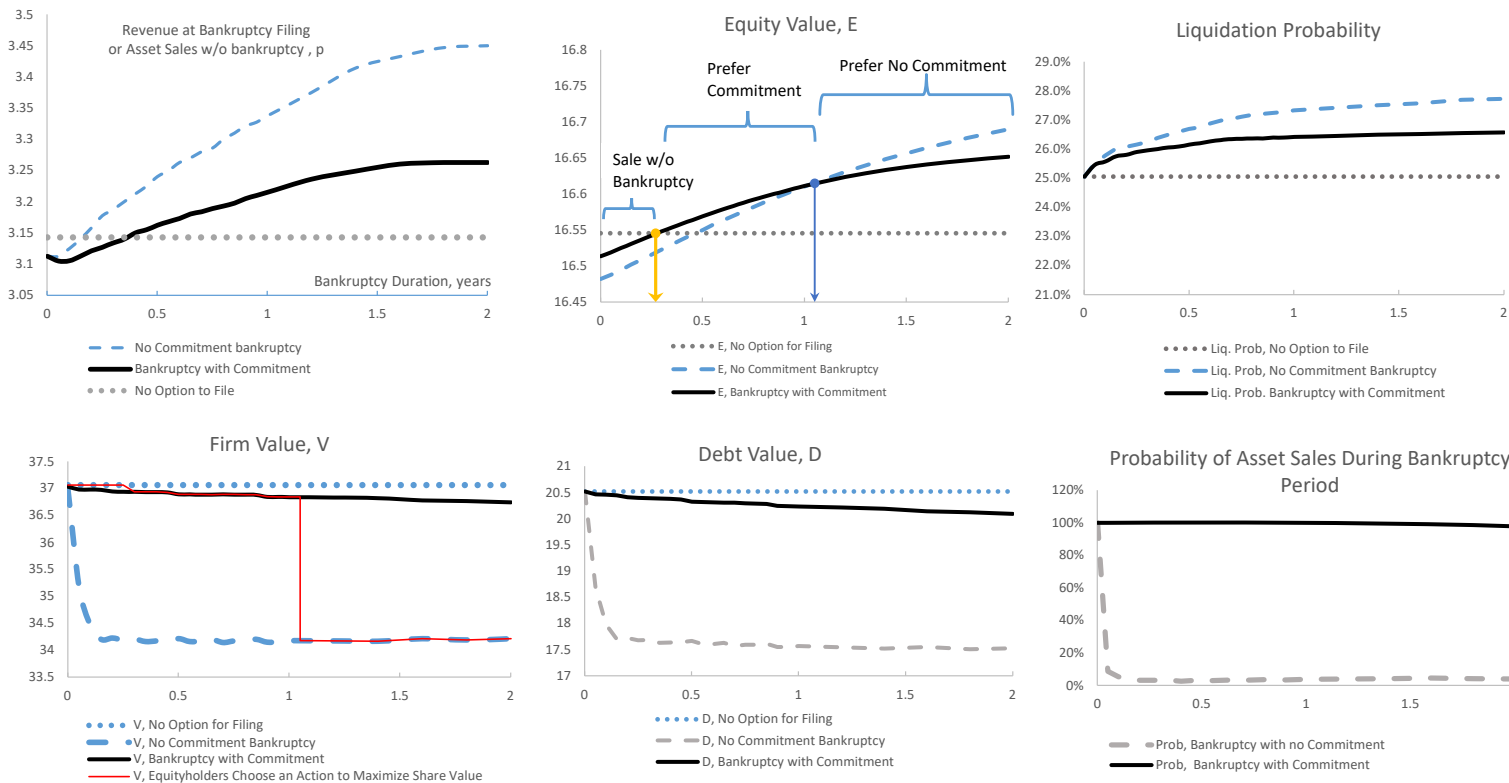
**Figure 2: Cumulative Filings by Year and Median Days in Bankruptcy**  
 Filings types are free-fall, pre-negotiated, and pre-packaged  
 Lines are median days in bankruptcy for each type



**Figures 3.**

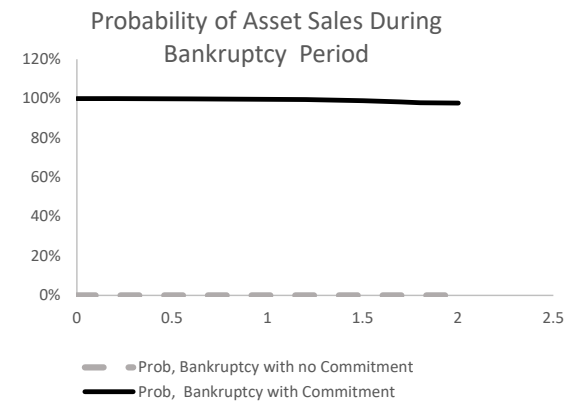
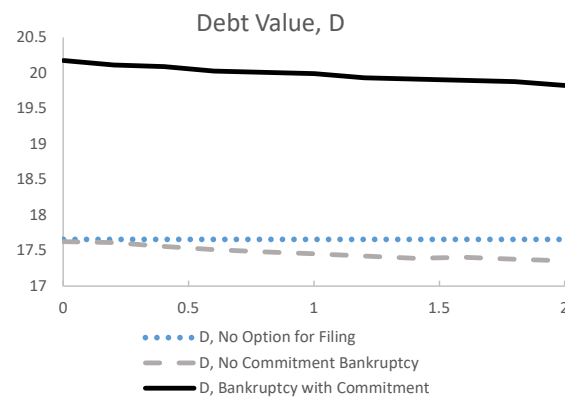
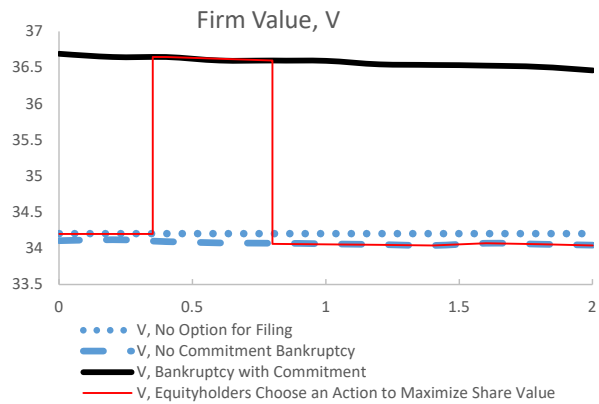
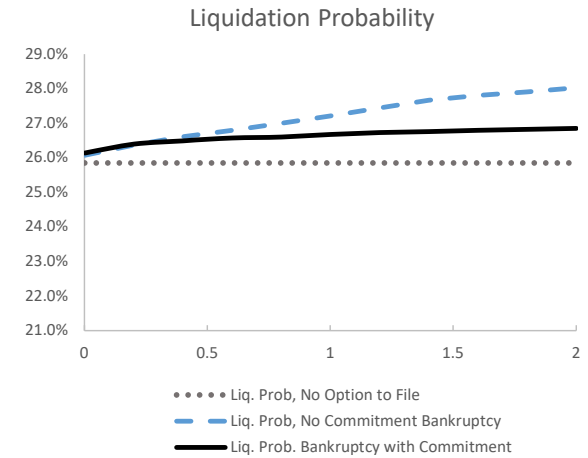
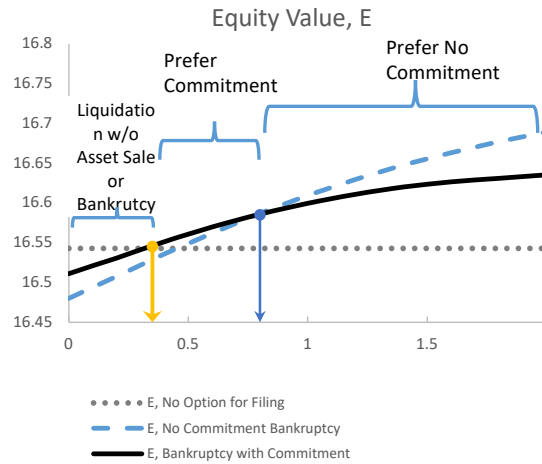
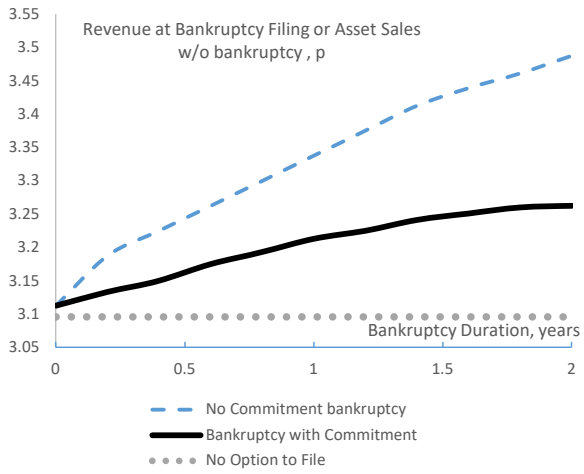
Graphs present the model results for the three firm types 1) The firm can liquidate or sell assets outside bankruptcy, but cannot file for bankruptcy protection; 2) the firm can file for Chapter 11 and commits to sell assets; or 3) the firm can file for Chapter 11 bankruptcy without commitment. When the firm files for either bankruptcy method, the bankruptcy court grants the firm "an automatic of stay" for a predetermined maximum duration, during which the firm suspends interest payments and dividends until the firm emerges from bankruptcy or liquidates. With the commitment, the firm has to sell assets any time during the protection period. With no commitment, the firm does not have to sell assets and the firm can choose to emerge from bankruptcy with or without assets sold, or liquidate. For the base case, the price for assets is relatively high, so the optimal boundary for asset sale is above the liquidation boundary, so firm type 1) executes sale outside the bankruptcy before it can liquidates if the revenue declines. The values are plotted for the revenue of  $p=6.0$  as a function of the maximum duration of the bankruptcy allowed by the courts. For each firm type, the values are calculated, assuming that the shareholders choose all actions, including bankruptcy filing and asset sales, that maximize their value. Vertical lines on the second graph denote the cross-over points that determines the duration (0.27 or 1.05 years, respectively) at which the shareholders (their values) are indifferent between choosing asset sales outside bankruptcy and the bankruptcy with commitment, or the bankruptcies with or without commitment, respectively. The probability that the firm will sell assets is calculated at the trigger point of entering the bankruptcy. The remaining parameters are as in the base case. In Panel 1, asset sale price  $S=12$ , for which the optimal boundary for asset sale is above the liquidation boundary, so the firm with no option to file for bankruptcy optimally chooses to sell assets outside bankruptcy before it liquidates if the revenue fall further. In Panel 2, the sale price of assets  $S=11$ , so the optimal boundary for asset sale is below the liquidation boundary.

**Panel 1, Asset Sale Price,  $S=12$**





**Figure 3.**  
**Panel 2, Asset Sale Price, S=11**



**Chart A:** The table presents the optimal shareholder's decision that the firm shareholders are expected to subsequently take, if its revenue declines low enough. The optimal choices are presented for different combinations of the sale price for the firm's assets and the maximum allowable bankruptcy duration set by the courts. The decisions are the following: The firm can liquidate without asset sales or sell part of its assets outside bankruptcy for a given sale price (Vertical), or the firm can enter Chapter 11 bankruptcy with a commitment to sell assets, or bankruptcy without commitment. When the firm enters either bankruptcy method, the bankruptcy court grants the firm "an automatic of stay" for a predetermined maximum duration of the protection period (Horizontal), during which the firm suspends interest payments and dividends until the firm emerges from bankruptcy or liquidates. Under the bankruptcy with commitment, the firm has to sell assets any time during the protection period. For bankruptcy with no commitment, the firm can choose to emerge from bankruptcy with or without assets sold, or choose to liquidate. Decisions are made, assuming that the equityholders choose timing of all subsequent actions (including bankruptcy filing, asset sales, emergence from bankruptcy or liquidation) to maximize equity value. The asterisk "\*" sign denotes the firm's choice that maximizes the total value of the firm for a given combination of protection period duration and the assets sale price. The face value of debt is  $D=23$ . The remaining parameters are as in the base case.

Bankruptcy Duration, $T$ in Years	Sale Price for Assets, $S$											
	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	
14	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Asset Sales w/o Bankruptcy*	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter No Commitment	Enter No Commitment	
13.5	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
13	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
12.5	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
12	Sell Assets w/o Bankruptcy*	Sell Assets w/o Bankruptcy*	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter with Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
11.5	Liquidation	Liquidation	Enter with Commitment*	Enter with Commitment*	Enter with Commitment*	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
11	Liquidation	Liquidation	Enter with Commitment*	Enter with Commitment*	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
10.5	Liquidation	Liquidation	Enter with Commitment*	Enter with Commitment*	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	
10	Liquidation*	Liquidation*	Liquidation*	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	Enter No Commitment	

### Table 1 Panel A, Summary Statistics

The first row reports the number of observations for each subgroup filing for bankruptcy for the period 1979-2021. *Compustat Obs* report the number of observations that report Total Assets in Compustat in at least one of three fiscal years preceding the bankruptcy declaration. *PP&E Chg Obs* reports the number of observations where we have both pre and post-bankruptcy observations in Compustat within three years either side for Net PP&E. Variable definitions are as follows: *Declare Year* - calendar year when bankruptcy filing occurred, *Liquidated* – dummy for if bankruptcy exit was via liquidation, *Merger* – dummy for if bankruptcy exit was via merger or acquisition, *Survived* – dummy if both *Liquidated* and *Merger* equal zero, *Shopped* – dummy for if bankruptcy filing was shopped across more than one court district, *Delaware Filed* – dummy for if bankruptcy was filed in Delaware, *NYSD Filed* – dummy for if bankruptcy was filed in the Southern District of New York, *Sale Intended* – dummy for if firm indicated an intention to sell a substantial fraction of assets as part of reorganization, *Asset Sales* – dummy for if firm sold a substantial fraction of assets while in bankruptcy, *Actual Days In* - number of days from filing date to confirmation date, conversion to Chapter 7 date, or dismissal date, *Duration Prior 2-yr* - Sample-wide *Days In* for free-fall filings over the previous two years, *Duration Prior 2-yr (District)* - Judicial district *Days In* for free-fall filings over the previous two years, *Z-score* -  $1.2*((\text{current assets}-\text{current liabilities})/\text{total assets}) + .6*(\text{retained earnings}/\text{total assets}) + 3.3*(\text{EBIT}/\text{total assets}) + 1.4*(\text{market cap}/\text{total liabilities}) + .999*(\text{sales}/\text{total assets})$ , *Z-score'* -  $0.717*((\text{current assets}-\text{current liabilities})/\text{total assets}) + 0.847*(\text{retained earnings}/\text{total assets}) + 3.107*(\text{EBIT}/\text{total assets}) + 0.420*(\text{book equity}/\text{total liabilities}) + 0.998*(\text{sale}/\text{total assets})$ . *Z-score''* -  $6.56*((\text{current assets}-\text{current liabilities})/\text{total assets}) + 3.26*(\text{retained earnings}/\text{total assets}) + 6.72*(\text{EBIT}/\text{total assets}) + 1.05*(\text{book equity}/\text{total liabilities})$ , *Delaware HQ* – dummy for if firm is incorporated in state of Delaware, *ROA\_COMP* - net income/total assets from Compustat, *ROA\_Lopucki* - net income/total assets from Lopucki, *Q* -  $(\text{total assets} - \text{book equity} + \text{market cap} - \text{deferred income tax})/\text{total assets}$ , *Firm Age* - Compustat establishment date minus filing date in years, *Assets\_COMP* – Compustat total assets from last financial statements prior to filing, *Assets\_Lopucki* – Lopucki total assets from last financial statements prior to filing, *Employees\_Lopucki* - total employees from last financial statements prior to filing, *Pct Asset Chg* – Lopucki percentage change in total assets from last financial statement prior to filing to first statement after emerging, *Pct Net PP&E Chg* - Compustat: percentage change in Net PP&E from last financial statement prior to filing to first statement after emerging.

	<i>Free-Fall</i>		<i>Pre-Negotiated</i>		<i>Pre-Packaged</i>	
	Mean	Median	Mean	Median	Mean	Median
<i>Observations</i>		785		246		143
<i>Declare Year</i>	2000	2000	2006	2006	2006	2007
<i>Liquidated</i>	0.37		0.12		0.05	
<i>Merger</i>	0.20		0.17		0.20	
<i>Survived</i>	0.44		0.70		0.76	
<i>Shopped</i>	0.61		0.74		0.74	
<i>Delaware Filed</i>	0.33		0.40		0.50	
<i>NYSD Filed</i>	0.18		0.24		0.19	
<i>Sale Intended</i>	0.29		0.17		0.08	
<i>Asset Sales</i>	0.52		0.44		0.31	
<i>Actual Days In</i>	648.8	502.5	244.7	158	65.6	45
<i>Duration Prior 2-yr</i>	543.3	522.5	447.4	460	437.8	432.5
<i>Duration Prior 2-yr (District)</i>	563.6	497.5	465.7	448.0	431.9	441.5
<i>Compustat Obs</i>		724		226		129
<i>Z-score</i>	2.12	1.67	0.85	0.86	0.67	0.73
<i>Z-score'</i>	1.09	1.21	0.27	0.58	0.34	0.81
<i>Z-score''</i>	1.08	1.72	-0.98	0.20	-1.34	0.24
<i>Delaware HQ</i>	0.68		0.80		0.74	
<i>Leverage</i>	0.53	0.54	0.69	0.74	0.73	0.79
<i>ROA_COMP</i>	-0.17	-0.08	-0.23	-0.14	-0.21	-0.14
<i>ROA_Lopucki</i>	-0.05	-0.01	-0.08	0	-0.05	0.01
<i>Q</i>	1.21	1.03	1.23	1.07	1.22	1.1
<i>Firm Age</i>	7.87	9.71	7.67	9.63	7.06	8.00
<i>Assets_Comp</i>	3,237	579	1,883	636	1,374	576
<i>Assets_Lopucki</i>	3,837	623	2,563	818	1,798	691
<i>Employees_Lopucki</i>	8,312	2,900	5,948	2,370	4,683	2,022
<i>PP&amp;E Chg Obs</i>		204		90		60
<i>Pct Asset Chg</i>	-32%	-33%	-24%	-29%	-20%	-25%
<i>Pct Net PP&amp;E Chg</i>	-38%	-39%	-27%	-27%	-33%	-34%
<i>Pct Empl Chg</i>	-32%	-35%	-24%	-19%	-6%	-3%

**Table 1 Panel B, Summary Statistics Split on Intention to Sell Assets**

	<i>No Intention to Sell</i>		<i>Intention to Sell</i>	
	Mean	Median	Mean	Median
<i>Observations</i>		531		211
<i>Declare Year</i>	1998	1999	2006	2006
<i>Liquidated</i>	0.27		0.62	
<i>Merger</i>	0.15		0.20	
<i>Survived</i>	0.68		0.18	
<i>Shopped</i>	0.55		0.75	
<i>Asset Sales</i>	0.42		0.72	
<i>Actual Days In</i>	698.5	530.0	521.0	381.5
<i>Duration Prior 2-yr</i>	579.4	533.0	453.0	455.3
<i>Duration Prior 2-yr (District)</i>	598.9	518.5	475.7	455.0
<i>Compustat Obs</i>		513		211
<i>Z-score</i>	1.17	1.10	2.28	1.25
<i>Z-score'</i>	0.81	0.59	0.59	0.78
<i>Z-score''</i>	-2.07	-0.77	-1.93	-0.16
<i>Delaware HQ</i>	0.67		0.72	
<i>Leverage</i>	0.61	0.58	0.49	0.33
<i>ROA_COMP</i>	-0.19	-0.08	-0.22	-0.11
<i>ROA_Lopucki</i>	-0.04	0.00	-0.10	-0.03
<i>Q</i>	1.19	1.04	1.27	1.01
<i>Firm Age</i>	7.90	9.71	7.75	9.63
<i>Assets_Comp</i>	3,821	683	1,817	445
<i>Assets_Lopucki</i>	4,436	628	2,337	606
<i>Employees_Lopucki</i>	9,493	3,433	5,349	2,012
<i>PP&amp;E Chg Obs</i>		193		11
<i>Pct Asset Chg</i>	-30%	-33%	-31%	-34%
<i>Pct Net PP&amp;E Chg</i>	-37%	-32%	-52%	-53%
<i>Pct Empl Chg</i>	-32%	-35%	-35%	-19%

**Table 2, Panel A: Z-score Prior to Bankruptcy Filing**

Ordinary least squares regressions where three different measures of *Z-score*, observed one quarter prior to the bankruptcy filing, are the dependent variable. *Z-score* includes market value of equity in its calculation. *Z-score'* substitutes book value of equity for market value. *Z-score''* drops the final term of Sales/Total Assets. Weights differ across the three measures. See the header of Table 1 for the exact calculation of each *Z-score* measure. *Expected Duration* is the median of sample-wide *Days In* for free-fall filings over the previous two years, i.e. median *Duration Prior 2-yr. Free-Fall* and *Pre-Negotiated* are dummy variables that are coded 1 for free-fall filings and pre-negotiated filings, respectively. *Delaware Inc* is coded 1 for firms that are incorporated in Delaware. *DE Filed* and *NYSD Filed* are dummy variables that are coded 1 when the bankruptcy filing occurs in Delaware or the Southern District of New York. *Ln(Assets)* is log of pre-bankruptcy total assets. *Firm Age* is Compustat establishment date minus filing date in years. *Bank* and *Utility* are dummy variables that are coded 1 for regulated financial institutions and for regulated utilities. Specifications 1, 3, and 5 have dummy variables for financial services and for utility firms. Specifications 2, 4, and 6 have Fama-French 12-digit industry fixed-effects in place of the two industry dummies. Heteroscedasticity consistent standard errors are clustered by Gvkey. Statistical significance at the 10%, 5%, and 1% levels is denoted by \*, \*\*, \*\*\*.

	Z-score		Z-score'		Z-score''	
	1	2	3	4	5	6
<i>Expected Duration</i>	0.086 (2.11)**	0.072 (1.86)*	0.110 (3.28)***	0.103 (3.36)***	0.201 (1.87)*	0.195 (2.02)**
<i>Free-Fall</i>	1.320 (3.37)***	1.043 (2.54)**	0.489 (2.48)**	0.318 (1.79)*	2.625 (3.77)***	2.236 (3.32)***
<i>Pre-Negotiated</i>	0.120 (0.40)	-0.017 (0.06)	-0.137 (0.59)	-0.194 (0.91)	0.366 (0.42)	0.140 (0.17)
<i>Delaware Inc.</i>	-0.100 (0.42)	0.026 (0.11)	-0.238 (1.67)*	-0.105 (0.79)	-0.911 (1.84)**	-0.640 (1.32)
<i>DE_filed</i>	0.398 (0.93)	0.234 (0.55)	0.03 (0.24)	-0.045 (0.37)	0.292 (0.59)	0.123 (0.28)
<i>NYSD_filed</i>	-0.214 (0.95)	-0.389 (1.62)	-0.075 (0.50)	-0.139 (1.08)	-0.398 (0.67)	-0.536 (0.96)
<i>Ln(Assets)</i>	-0.433 (5.09)***	0.831 (1.99)**	-0.517 (11.18)***	0.763 (2.15)**	-1.029 (6.01)***	3.389 (2.67)***
<i>Firm Age</i>	-0.169 (2.19)**	-0.162 (1.96)*	0.007 (0.43)	-0.005 (-0.33)	-0.105 (1.61)	-0.144 (2.18)**
<i>Bank</i>	0.173 (0.32)		-0.098 (0.18)		-0.365 (0.19)	
<i>Utility</i>	-1.884 (4.71)***		-1.516 (6.95)***		-1.640 (2.13)**	
<i>Constant</i>	2.905 (4.80)***	-2.662 (1.14)	1.866 (6.66)***	-3.900 (2.05)**	0.042 (0.04)	-21.113 (3.16)***
Industry FE	No	Yes	No	Yes	No	Yes
Observations	751	751	889	889	889	889
R-squared	0.057	0.073	0.183	0.298	0.097	0.152

**Table 2, Panel B: Z-score Prior to Bankruptcy Filing – Free-Fall Filings Only**

	Z-score		Z-score'		Z-score''	
	1	2	3	4	5	6
<i>Expected Duration</i>	0.110 (2.12)**	0.098 (2.12)**	0.099 (2.62)***	0.094 (2.57)***	0.304 (2.65)**	0.287 (2.56)***
<i>Delaware Inc.</i>	-0.027 (0.09)	0.088 (0.30)	-0.165 (0.99)	-0.054 (0.34)	-0.585 (1.05)	-0.380 (0.69)
<i>DE_filed</i>	0.549 (0.87)	-0.410 (0.66)	0.026 (0.17)	0.006 (0.04)	0.460 (0.86)	0.363 (0.72)
<i>NYSD_filed</i>	-0.315 (1.14)	-0.472 (1.60)	-0.002 (0.01)	-0.009 (0.41)	0.037 (0.06)	-0.213 (0.35)
<i>Firm Age</i>	-0.266 (2.36)**	-0.246 (2.05)**	-0.004 (0.20)	-0.009 (0.41)	-0.159 (2.05)**	-0.164 (2.19)**
<i>Ln(Assets)</i>	-0.432 (3.90)***	-0.162 (-0.34)	-0.528 (8.05)***	-0.214 (-0.62)	-1.157 (5.01)***	-0.299 (0.21)
<i>Bank</i>	0.668 (0.99)		0.022 (0.03)		-0.956 (0.41)	
<i>Utility</i>	-2.109 (5.20)***		-1.686 (-5.90)***		-1.985 (2.26)**	
<i>Constant</i>	4.786 (5.77)***	3.996 (1.42)	2.605 (7.76)***	1.402 (0.81)	2.715 (2.41)**	-0.811 (0.11)
Industry FE	No	Yes	No	Yes	No	Yes
Observations	509	509	583	583	583	583
R-squared	0.034	0.057	0.150	0.267	0.074	0.112

**Table 3: Intention to Sell Assets Prior to Bankruptcy Filing**

Logistics regressions where dependent variable is *Sale Intended Dummy*, which is coded one when the firm indicates an intention to sell all or substantially all assets as part of their reorganization. *Expected Duration* is the median of sample-wide *Days In* for free-fall filings over the previous two years, i.e. median *Prior 2-yr Duration*. *Free-Fall* and *Pre-Negotiated* are dummy variables that are coded 1 for free-fall filings and pre-negotiated filings, respectively. *Delaware Inc* is coded 1 for firms that are incorporated in Delaware. *DE Filed* and *NYSD Filed* are dummy variables that are coded 1 when the bankruptcy filing occurs in Delaware or the Southern District of New York. *Ln(Assets)* is log of pre-bankruptcy total assets. See the header of Table 1 for the formula for *Z-score*'. *Firm Age* is Compustat establishment date minus filing date in years. *Bank* and *Utility* are dummy variables that are coded 1 for regulated financial institutions and for regulated utilities. Specifications 1 and 3 have dummy variables for financial services and for utility firms. Specifications 2 and 4 have Fama-French 12-digit industry fixed-effects in place of the two industry dummies. Heteroscedasticity consistent standard errors are clustered by Gvkey. Statistical significance at the 10%, 5%, and 1% levels is denoted by \*, \*\*, \*\*\*.

	Sale Intended Dummy		Free-Fall Only, Sale Intended Dummy	
	1	2	3	4
<i>Expected Duration</i>	-0.323 (3.64)***	-0.367 (3.98)***	-0.497 (4.66)***	-0.534 (2.91)***
<i>Free-Fall</i>	1.904 (5.09)***	2.006 (5.12)***		
<i>Pre-Negotiated</i>	0.806 (2.02)**	0.910 (2.19)**		
<i>Delaware Inc.</i>	0.252 (1.23)	0.219 (1.05)	0.265 (1.11)	0.200 (0.81)
<i>DE Filed</i>	0.400 (2.02)**	0.398 (1.95)**	0.344 (1.47)	0.330 (1.35)
<i>NYSD Filed</i>	-0.477 (1.79)*	-0.520 (1.87)*	-0.387 (1.23)	-0.441 (1.32)
<i>Ln(Assets)</i>	-0.036 (0.51)	-1.123 (3.11)***	-0.004 (0.04)	-0.931 (1.99)**
<i>Z-score</i> '	0.010 (0.24)	0.041 (0.89)	0.005 (0.09)	0.041 (0.66)
<i>Firm Age</i>	-0.072 (2.50)***	-0.064 (2.13)**	-0.079 (2.22)**	-0.070 (1.85)*
<i>Bank</i>	0.862 (1.16)		1.290 (1.52)*	
<i>Utility</i>	-1.710 (1.60)*		-1.486 (1.28)	
<i>Constant</i>	-0.529 (0.74)	3.867 (2.51)***	2.110 (2.57)***	5.974 (2.91)***
Industry FE	No	Yes	No	Yes
Observations	735	735	453	453



**Table 4: Actual Sales of Assets Subsequent to Filing for Bankruptcy**

Logistics regressions where the dependent variable is *Sale Dummy*, which is coded one when the firm sells assets as part of their reorganization. *Expected Duration* is the median of sample-wide *Days In* for free-fall filings over the previous two years, i.e. median *Prior 2-yr Duration*. *Sale Intended* is a dummy variable that is coded 1 when the firm indicated an intention to sell a substantial fraction of assets as part of reorganization. *Free-Fall* and *Pre-Negotiated* are dummy variables that are coded 1 for free-fall filings and pre-negotiated filings, respectively. *Delaware Inc* is coded 1 for firms that are incorporated in Delaware. *DE Filed* and *NYSD Filed* are dummy variables that are coded 1 when the bankruptcy filing occurs in Delaware or the Southern District of New York. *Ln(Assets)* is log of pre-bankruptcy total assets. See the header of Table 1 for the formula for *Z-score*'. *Firm Age* is Compustat establishment date minus filing date in years. *Bank* and *Utility* are dummy variables that are coded 1 for regulated financial institutions and for regulated utilities. Specifications 1 and 3 have dummy variables for financial services and for utility firms. Specifications 2 and 4 have Fama-French 12-digit industry fixed-effects in place of the two industry dummies. Heteroscedasticity consistent standard errors are clustered by Gvkey. Statistical significance at the 10%, 5%, and 1% levels is denoted by \*, \*\*, \*\*\*.

	Sale Dummy		Free-Fall Only, Sale Dummy	
	1	2	3	4
<i>Expected Duration</i>	-0.279 (3.16)***	-0.327 (3.88)***	-0.337 (2.48)***	-0.433 (3.40)***
<i>Sale Intended</i>	1.379 (6.55)***		1.250 (5.15)***	
<i>Free-Fall</i>	1.201 (4.32)***	1.522 (5.59)***		
<i>Pre-Negotiated</i>	0.534 (1.85)*	0.658 (2.32)**		
<i>Delaware Inc.</i>	0.261 (1.40)	0.311 (1.74)*	0.299 (1.23)	0.291 (1.28)
<i>DE Filed</i>	0.012 (0.07)	0.103 (0.57)	0.299 (1.23)	0.358 (1.55)
<i>NYSD Filed</i>	-0.012 (0.05)	-0.101 (0.46)	0.107 (0.36)	0.024 (0.08)
<i>Ln(Assets)</i>	0.038 (0.56)	0.031 (0.46)	-0.053 (0.55)	-0.048 (0.52)
<i>Z-score</i> '	0.006 (0.15)	0.007 (0.18)	-0.003 (0.05)	-0.005 (0.08)
<i>Firm Age</i>	0.058 (2.06)**	0.04 (1.38)	0.064 (1.76)*	0.041 (1.16)
<i>Bank</i>	-0.16 (0.15)	0.050 (0.06)	-0.762 (0.74)	-0.363 (0.40)
<i>Utility</i>	-0.772 (1.12)	1.031 (1.55)*	-2.445 (2.50)***	-2.699 (2.84)***
<i>Constant</i>	-0.571 (0.87)	0.106 (0.17)	1.21 (1.25)	2.17 (2.38)**
Industry FE	No	No	No	No
Observations	735	735	453	453

**Table 5: Filing Choice Regressions – Free Fall = 0, Pre-Negotiated = 1, and Pre-Packaged = 2**

Multinomial (first two columns) and ordinal logit regressions of whether the bankruptcy filing is free-fall (0), pre-negotiated (1) or pre-packaged (2). In the ordinal logit regressions, the dependent variable is coded zero for free-fall with no announced intention to sell assets, one for free-fall with an announced intention to sell assets, two for pre-negotiated with no announced intention to sell assets, etc. *Expected Duration* is the median of sample-wide *Days In* for free-fall filings over the previous two years, i.e. median *Prior 2-yr Duration*. *Delaware Inc* is coded 1 for firms that are incorporated in Delaware. *DE Filed* and *NYSD Filed* are dummy variables that are coded 1 when the bankruptcy filing occurs in Delaware or the Southern District of New York. *Ln(Assets)* is log of pre-bankruptcy total assets. See the header of Table 1 for the formula for *Z-score*'. *Firm Age* is Compustat establishment date minus filing date in years. *Bank* and *Utility* are dummy variables that are coded 1 for regulated financial institutions and for regulated utilities. Heteroscedasticity consistent standard errors are clustered by Gvkey. Statistical significance at the 10%, 5%, and 1% levels is denoted by \*, \*\*, \*\*\*.

	Multinomial		Ordinal
	Pre-Neg	Pre-Pac	
<i>Expected Duration</i>	-0.410 (6.51)***	-0.545 (5.26)***	-0.463 (7.11)***
<i>Delaware Inc</i>	0.326 (1.53)*	0.012 (0.05)	0.336 (2.12)**
<i>DE Filed</i>	0.398 (1.94)**	0.906 (3.67)***	0.599 (3.94)***
<i>NYSD Filed</i>	0.460 (2.00)**	0.460 (1.46)	0.361 (1.90)**
<i>Ln(Assets)</i>	-0.019 (0.26)	0.063 (0.64)	0.040 (0.67)
<i>Z-score</i> '	-0.188 (3.39)***	-0.158 (2.52)**	-0.110 (3.12)***
<i>Firm Age</i>	-0.016 (0.55)	-0.095 (2.63)***	-0.049 (2.16)**
<i>Bank</i>	-1.11 (1.06)	0.445 (0.66)	-0.250 (0.47)
<i>Utility</i>	-0.016 (0.03)	0.205 (0.23)	0.398 (0.70)
<i>Constant</i>	0.710 (1.17)	0.914 (1.14)	1.359 (2.66)***
Observations	196	110	735

**Table 6a: Multinomial Exit Regressions**

Multinomial logit regressions where *Exit* is the dependent variable. *Exit* is coded 1 for firms that were liquidated or converted to Chapter 7 bankruptcies, 2 for firms that were sold to or merged with another firm, and 3 for firms that successfully exit Chapter 11 as independent companies. Successful exit (3) is the base case. *Expected Duration* is the median of sample-wide *Days In* for free-fall filings over the previous two years, i.e. median *Prior 2-yr Duration*. *Sale Intended* is a dummy variable that is coded 1 when the firm indicated an intention to sell a substantial fraction of assets as part of reorganization. *Free-Fall* and *Pre-Negotiated* are dummy variables that are coded 1 for free-fall filings and pre-negotiated filings, respectively. *Delaware Inc* is coded 1 for firms that are incorporated in Delaware. *DE Filed* and *NYSD Filed* are dummy variables that are coded 1 when the bankruptcy filing occurs in Delaware or the Southern District of New York. *Ln(Assets)* is log of pre-bankruptcy total assets. See the header of Table 1 for the formula for *Z-score*'. *Firm Age* is Compustat establishment date minus filing date in years. *Bank* and *Utility* are dummy variables that are coded 1 for regulated financial institutions and for regulated utilities. Heteroscedasticity consistent standard errors are clustered by *Gvkey*. Statistical significance at the 10%, 5%, and 1% levels is denoted by \*, \*\*, \*\*\*.

	Full Sample				Free-Fall Only			
	1		2		3		4	
	Liq.	Merged	Liq.	Merged	Liq.	Merged	Liq.	Merged
<i>Expected Duration</i>	0.443 (4.76)***	0.526 (6.04)***	0.429 (4.03)***	0.550 (5.35)***	0.475 (4.44)***	-0.516 (4.93)***	0.456 (3.72)***	0.554 (4.44)***
<i>Sale Intended</i>	1.803 (8.64)***	1.261 (5.38)***	1.920 (7.99)***	1.407 (5.27)***	1.680 (7.35)***	1.309 (4.76)***	1.830 (6.70)***	1.447 (4.54)***
<i>Free-Fall</i>	2.315 (4.85)***	1.161 (2.84)***	2.613 (4.26)***	1.078 (2.47)**				
<i>Pre-negotiated</i>	0.306 (0.57)	0.387 (0.86)	0.573 (0.84)	-0.069 (0.14)				
<i>Delaware Inc.</i>			-0.032 (0.13)	0.710 (2.46)***			0.006 (0.02)	0.477 (1.47)
<i>DE Filed</i>			-0.345 (1.41)	-0.500 (1.80)			-0.406 (1.49)	-0.291 (0.92)
<i>NYSD Filed</i>			-0.695 (2.11)**	-0.091 (0.29)			-0.578 (1.60)*	-0.109 (0.28)
<i>Ln(Assets)</i>			0.117 (1.25)	-0.250 (2.47)**			0.096 (0.94)	-0.336 (2.56)**
<i>Z-score</i> '			0.054 (0.90)	-0.131 (2.39)**			0.088 (0.86)	-0.340 (2.59)***
<i>Firm Age</i>			-0.058 (1.64)*	0.016 (0.38)			-0.067 (1.66)*	-0.002 (0.04)
<i>Bank</i>	1.290 (4.03)***	-0.249 (0.56)	2.113 (2.79)***	0.531 (0.52)	1.216 (3.35)***	-0.394 (0.90)	14.348 (21.89)***	13.011 (13.69)***
<i>Utility</i>	-0.459 (0.54)	-0.724 (0.64)	-0.449 (0.36)	-1.058 (0.91)	-0.508 (0.59)	-13.71 (3.64)***	-0.594 (0.47)	-14.04 (22.27)***
<i>Constant</i>	-5.325 (8.22)***	-4.934 (8.07)***	-5.436 (5.57)***	-4.293 (4.39)***	-3.102 (5.59)***	-3.729 (6.70)	-2.712 (2.82)***	-2.670 (2.47)**
Obs	867		722		547		446	

**Table 6b: Binomial Bankruptcy Exit Regressions**

Binomial logit regressions where *Survive* and *Liquidation* are the dependent variables. *Survive* is coded 1 for firms that successfully exit Chapter 11 as independent companies. If the bankrupt firm was sold to or merged with another firm or the firm was liquidated or converted to Chapter 7, then *Survive* is coded 0. *Liquidation* is coded 1 for firms that were liquidated or converted to Chapter 7, 0 otherwise. See Panel A for definitions of all variables. Heteroscedasticity consistent standard errors are clustered by Gvkey. Statistical significance at the 10%, 5%, and 1% levels is denoted by \* \*\* \*\*\*

	Full Sample				Free-Fall Only			
	Survive		Liquidation.		Survive		Liquidation	
	1	2	3	4	5	6	7	8
<i>Expected Duration</i>	-0.465 (6.77)***	-0.473 (5.58)***	0.386 (5.61)***	0.409 (4.99)***	-0.493 (5.31)***	-0.483 (4.60)***	0.319 (3.67)***	0.304 (3.06)***
<i>Sale Intended</i>	-1.633 (9.44)***	-1.718 (8.22)***	1.774 (11.15)***	1.782 (9.16)***	-1.563 (7.43)***	-1.692 (6.89)***	1.303 (6.65)***	1.412 (6.23)***
<i>Free-Fall</i>	-1.779 (6.15)***	-1.797 (4.89)***						
<i>Pre-negotiated</i>	-0.524 (1.63)	-0.361 (0.87)						
<i>Delaware Inc.</i>		0.256 (0.29)		-0.088 (0.42)		0.126 (0.55)		-0.017 (0.07)
<i>DE Filed</i>		0.428 (2.08)**		-0.437** (2.15)		0.370 (1.55)		-0.356 (1.52)
<i>NYSD Filed</i>		0.422 (1.61)*		-0.730 (2.61)**		0.438 (1.42)		-0.598 (1.90)*
<i>Ln(Assets)</i>		0.022 (0.29)		0.098 (1.25)		0.061 (0.67)		0.116 (1.29)
<i>Z-score'</i>		0.036 (0.72)		0.176 (3.00)**		0.003 (0.07)		0.129 (2.25)**
<i>Firm Age</i>		0.036 (1.20)		-0.035 (1.17)		0.052 (1.40)		-0.053 (1.52)
<i>Bank</i>	-0.767 (2.77)***	-1.460 (2.13)**	1.188 (4.70)***	2.246 (3.15)***	-0.890 (2.57)***	-14.80 (27.21)***	1.210 (3.83)***	15.70 (28.45)***
<i>Utility</i>	0.527 (0.77)	0.650 (0.78)	-0.099 (0.13)	-0.102 (0.10)	0.775 (1.09)	1.201 (1.27)	-0.786 (0.88)	-1.093 (0.79)
<i>Constant</i>	4.297 (9.65)***	3.924 (5.27)***	-3.378 (9.78)***	-3.359 (4.72)***	2.665 (5.59)***	1.840 (2.23)**	-2.409 (5.29)***	-2.310 (2.75)***
Obs	964	735	964	735	556	453	556	453

**Table 7: Asset Change and Employee Change Regressions**

Two stage selection regression models. The first stage is a probit model where the dependent variable is whether the firm survives bankruptcy and exits as an independent company. The second stage is Ordinary Least Squares. The dependent variables measure the percentage change in net PPE or in employees from the last available accounting statements prior to filing for bankruptcy to the first statements available after the reorganization plan was confirmed. *Expected Duration* is the median of sample-wide *Days In* for free-fall filings over the previous two years, i.e. median *Prior 2-yr Duration*. *Free-Fall* and *Pre-Negotiated* are dummy variables that are coded 1 for free-fall filings and pre-negotiated filings, respectively. *Ln(Assets)* is log of pre-bankruptcy total assets. *Bank* and *Utility* are dummy variables that are coded 1 for regulated financial institutions and for regulated utilities. Heteroscedasticity consistent standard errors are clustered by Gvkey. Statistical significance at the 10%, 5%, and 1% levels is denoted by \*, \*\*, \*\*\*.

	Percent Change in Net PP&E		Percent Change in Employees	
	1	2	3	4
	Full Sample	Free-Fall Only	Full Sample	Free-Fall Only
<i>Expected Duration</i>	-0.038 (2.50)**	-0.059 (2.99)***	-0.033 (2.64)***	-0.034 (2.06)**
<i>Free-Fall</i>	-0.109 (1.37)		-0.254 (4.44)***	
<i>Pre-Negotiated</i>	-0.021 (0.31)		-0.125 (2.65)***	
<i>Ln(Assets)</i>	-0.057 (3.43)***	-0.057 (2.32)**	-0.028 (2.23)**	-0.033 (1.80)*
<i>Bank</i>	-0.296 (2.10)**	-0.391 (2.29)**	-0.298 (2.69)***	-0.471 (3.36)***
<i>Utility</i>	0.007 (0.20)	0.062 (0.30)	0.020 (0.19)	0.034 (0.23)
<i>First stage rho</i>	-0.078 (0.38)	-0.398 (1.87)*	0.160 (0.78)	0.102 (0.29)
<i>Constant</i>	0.211 (1.56)	0.342 (1.50)	0.168 (1.65)	-0.042 (0.22)
Observations	622	440	614	426