INTERNATIONAL ECONOMIC REVIEW
Vol. 49, No. 2, May 2008

CORPORATE BANKRUPTCY REORGANIZATIONS: ESTIMATES FROM A BARGAINING MODEL*

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This article uses a novel approach to measure the unobserved liquidation value of a firm that relies on the information contained in the allocations that are agreed upon in Chapter 11 negotiations. I estimate a game theoretic model that captures the influence of liquidation value on the equilibrium allocations using a newly collected data set. I find that the liquidation values are higher when the industry conditions are more favorable, and the real interest rates are higher. I use the estimated model to conduct a counterfactual experiment to quantitatively assess the impact of a mandatory liquidation on the equilibrium allocations.

1. INTRODUCTION

When a firm files for Chapter 11 bankruptcy in the United States, negotiations take place among its claimants to decide what to do with the firm and who gets what. If an agreement cannot be reached, then the firm is likely to be liquidated. Consequently, the liquidation value of the firm plays a crucial role in the deal that is struck among the claimants. The goal of this article is to use this insight to quantify the liquidation value. In order to do so, I estimate a structural model of multilateral bargaining that captures the basic elements of the negotiations in Chapter 11 using a newly collected data set. This novel approach also allows me to conduct policy experiments to quantitatively assess the effects of various possible reforms to the bankruptcy law.

There are two reasons why measuring a firm's liquidation value is important. First, it is the building block for many capital structure theories. These theories predict the leverage ratio, the maturity of the debt, and the number of creditors to depend on the liquidation value of the firm in important ways (see, e.g., Williamson, 1988; Harris and Raviv, 1990; Aghion and Bolton, 1992; Shleifer and Vishny, 1992; Hart and Moore, 1994; Bolton and Scharfstein, 1996; Diamond, 2004).[2] A higher

*Manuscript received July 2003; revised September 2006.

[1] I thank two anonymous referees for their thoughtful comments and suggestions. I also thank Daniel Bussell, Philip Bond, John Geweke, John Kareken, Kenneth Klee, Andrew McLennan, Antonio Merlo, and Per Strömberg for helpful discussions. I am grateful to Lynn LoPucki many helpful conversations and data support, and to Tjomme Rusticus for his excellent assistance on data collection. Financial support from the National Science Foundation, Graduate School Dissertation Fellowship of the University of Minnesota, and Ford Motor Company Grant from Rodney L. White Center for Financial Research of the University of Pennsylvania is gratefully acknowledged. Please address correspondence to: Hülya K. K. Eraslan, Finance Department, the Wharton School, University, of Pennsylvania, Philadelphia, PA 19104-6367, U.S.A. Phone: 215-898-9424. E-mail: *eraslan@wharton.upenn.edu.*

[2] See Harris and Raviv (1991) for a survey of the capital structure literature.

liquidation value allows the firm to borrow at more attractive terms, from fewer creditors. Measuring a firm's liquidation value is thus central to the understanding of its capital structure decisions.

Second, liquidation value has important policy implications for the debate on the design of bankruptcy laws. Critics of Chapter 11 argue that it is costly, keeps inefficient firms operating and gives an unfair advantage to bankrupt firms compared to their nonbankrupt competitors. Consequently, there is a body of literature calling for repeal of Chapter 11 and proposing the mandatory liquidation of all bankrupt firms (see, e.g., Baird, 1986; Jackson, 1986). On the other hand, there are scholars who take the view that large distressed corporations cannot be sold intact, and the difference between the going concern value and the liquidation value can be substantial (see, e.g., LoPucki and Whitford, 1990; Aghion et al., 1992; Shleifer and Vishny, 1992). Consistent with this view, many countries recently revised their bankruptcy laws toward systems that resemble Chapter 11.

Information on the magnitude of liquidation value relative to going concern value would be useful towards resolving this debate. Measuring the liquidation value of a firm relative to its going concern value is complicated because one either observes the liquidation value of a firm or its reorganization value. Furthermore, whether a firm chooses to reorganize or liquidate is itself endogenous. One way to deal with this problem is to first specify a pricing model that describes the reorganization value as a function of various firm, industry, and macroeconomic characteristics, and then compare the implied prices to actual prices received by the firms in liquidating their assets. Obviously, this approach is sensitive to the pricing model being correctly specified.[3]

In this article, I use a novel approach to measure the unobserved liquidation value of a firm that relies on the information contained in the agreed upon allocations in Chapter 11 negotiations. I do so by estimating a game theoretic model that captures the influence of liquidation value on the equilibrium allocations. The model I consider is a complete information multilateral bargaining game in which secured creditors, unsecured creditors, and equityholders bargain over what to do with the firm (i.e., reorganize or liquidate) and how to split the surplus.[4] My model differs from the existing literature on bargaining in Chapter 11 (Baird and Picker, 1991; Bebchuk and Chang, 1992; Kordana and Posner, 1999) by explicitly modeling the negotiations as a multilateral bargaining game with random proposers

[3] Using this approach, Pulvino (1998) and Strömberg (2000) find that liquidation values are low relative to going concern values. On the other hand, Maksimovic and Phillips (1998) and Eckbo and Thorburn (2005) find no evidence of a discount in liquidation relative to reorganization. In addition to these papers, which focus on estimating liquidation value, there a number of studies are concerned with the effect of liquidation values on financial contracts. Such papers approximate the liquidation values using various firm specific information. For example, Alderson and Betker (1995) use management's reported estimates, Benmelech et al. (2005) measure liquidation value by zoning flexibility in the context of commercial loan contracts, and Acharya et al. (2005) use specific assets and intangible assets as proxies for liquidation value.

[4] Although the management may have superior information about the value of the firm in small cases, it is often recognized that in a large bankruptcy case, the creditors come to the bargaining table with a great deal of information. Therefore, I use a complete information bargaining model.

over multiple issues (i.e., the fate of the firm and the division of the surplus).[5] In any period when an agreement cannot be reached, there is a chance that the case is converted to Chapter 7 and the firm is liquidated. In that case, the payoffs of the claimants are given by an exogenous allocation that depends on the liquidation value of the firm. In equilibrium, the allocation that is agreed upon reflects this break-up value. As a result, by observing the actual agreements that are reached, I am able to make inferences about the liquidation value. I estimate the model using a newly collected data set of 128 Chapter 11 bankruptcies.

The estimates indicate that the liquidation value relative to reorganization value is on the average 82% of the reorganization value. For the firms that actually reorganize, the liquidation value is on the average 75% of the firm value. The variation among the firms is large enough to suggest that at least for some firms, the cost of mandatory liquidation is low. However, the cost mainly depends on aggregate and industry conditions, rather than observable firm specific variables, making it difficult to design a bankruptcy procedure that discriminates among firms. I use the estimated model to conduct a counterfactual experiment to quantitatively assess the impact of a mandatory liquidation on the equilibrium allocations. I show that such a policy would hurt all the claimants, but unsecured creditors and equityholders would lose disproportionately more than the secured creditors.

This article also makes a contribution to the estimation of noncooperative bargaining models. Although there is a large literature that incorporates noncooperative bargaining models in applied frameworks, there are only few studies that estimate the parameters of the noncooperative bargaining models. Notable exceptions are Merlo (1997), Sieg (2000), Diermeier et al. (2002, 2003), and Watanabe (2006). Merlo (1997) estimates a stochastic bargaining model of government formation in postwar Italy to explain the duration of the governments. Sieg (2000) uses generalized method of moments in the context of a finite horizon asymmetric information bargaining model using data on medical malpractice disputes. Diermeier et al. (2002, 2003) estimate stochastic bargaining models to investigate specific institutional features of parliamentary democracy on the formation and dissolution of coalition governments. Watanabe (2006) estimates a dynamic bargaining model of dispute resolution with learning using microdata on medical malpractice disputes. To my knowledge, this is the first article that estimates a multilateral bargaining model in which the observed variables include how the surplus is allocated among the negotiating parties.

The rest of the article is organized as follows. In Section 2, I briefly summarize the U.S. bankruptcy law. Section 3 lays out the model and characterizes the equilibrium. In Section 4, I describe the data, and in Section 5, I derive the likelihood function that is the basis of the estimation. The results are presented in Section 6. Section 7 presents the results of simulations to estimate the liquidation value and conducts counterfactual policy experiments.

[5] Kordana and Posner note that it is difficult to model multiparty negotiations, and because they found no such models appropriate for Chapter 11, they describe the effects of having multiple creditors in their model somewhat impressionistically.

2. A BRIEF OVERVIEW OF CHAPTER 11

In the United States a firm can file for bankruptcy either under Chapter 7 or under Chapter 11 of the Bankruptcy Code.[6] If the firm files for Chapter 7, then it is liquidated. If the firm files for Chapter 11, then whether the firm is reorganized or liquidated is determined through negotiations among claimants of the firm. In practice, large corporations only file under Chapter 11, but a large firm can still end up in Chapter 7 through the conversion of the case to Chapter 7 by the court. Since liquidation sets the framework for the bargaining under Chapter 11, I start by describing the liquidation procedure under Chapter 7.

CHAPTER 7: When a firm files for Chapter 7, an *automatic stay* goes into effect that prevents the creditors seizing the firm's assets. A trustee is appointed to liquidate the firm. He sells the firm's assets either as a going concern or piecemeal. In either case, the proceeds are distributed to claimants according to a ranking called the absolute priority rule. Under absolute priority rule, secured creditors are paid first, unsecured creditors are paid next, and the equityholders are paid last.

CHAPTER 11: The goal of Chapter 11 is to reorganize the firm when its reorganization value exceeds its liquidation value. This is decided by the claimants of the firms, which include secured creditors, unsecured creditors, and equityholders through a bargaining process. As in Chapter 7, an automatic stay goes into effect during the bankruptcy.

The Chapter 11 bankruptcy process begins when a petition is filed under Chapter 11 of the Code, which is designed to keep the firm operating and to protect its assets while a reorganization plan is being negotiated.

The plan needs to specify what to do with the firm (i.e., whether to reorganize or liquidate) as well as the allocations to its claimants in return for cancellation of their original claims against the firm. The claimants are grouped into classes according to the type of claims they hold, e.g., secured creditors, unsecured creditors, equityholders, etc. A plan is confirmed if it is feasible and all classes accept it.[7]

Under the "cram-down" provisions of the law, even if a class votes against the plan, it can be confirmed so long as that class receives a payment equal to what it would receive under absolute priority rule. A typical firm in Chapter 11 has debt capacity below what it had prior to bankruptcy. Consequently, the allocations to the creditors almost always involve common stock in addition to cash and debt. Because of this, the application of cram-down is limited in practice (see, e.g., Franks and Tourous, 1989). As a result, most plans are consensual since the cost of verifying that a class is receiving as much as it would under absolute priority rule is considered to be high. In fact, it is these considerations that led Congress to enact Chapter 11 so that the court's role is not that of valuing the business, but rather supervising the negotiations among parties who have better information about the firm. However, when the firm is deeply insolvent, it is relatively straightforward

[6] The Bankruptcy Code is available online at http://www4.law.cornell.edu/uscode/11.

[7] Acceptance of a plan by a class requires that the holders of a majority of the number of claims within the class and two-thirds of the amount of debt owed to that class vote in favor of the plan.

to argue that the equityholders are not entitled to any payment under absolute priority rule. In such cases, the equityholders are left out of the negotiations and the fate of the firm as well as who gets what is decided by the rest of the claimants.

The management has the exclusive power to propose the plan during the first four months.[8] Typically it develops the plan with a co-proponent that represents a claimant class. If a plan cannot be confirmed, then the parties continue negotiating. If no progress is made toward agreement, then the court can decide to convert the case to Chapter 7.[9]

3. MODEL

I model the negotiations among secured creditors, unsecured creditors, and equityholders in a corporate bankruptcy reorganization as an infinite horizon multilateral bargaining game with complete information.

3.1. *The Game.* There are three players: secured creditors s, unsecured creditors u, and the equityholders e. The amount of debt that the firm owes to creditor $i = s, u$, is given by D_i. In each period, a player is randomly selected to offer a proposal that specifies what to do with the firm (reorganize or liquidate) and how to split the value among the players.[10] I assume the probability of being selected as the proposer for player i is stationary and is given by $\pi_i \geq 0, \pi_s + \pi_u + \pi_e = 1$. Note that it is possible that $\pi_i = 0$ for some player, in which case the negotiation takes place between the other two players.[11]

The reorganization value of the firm is V^R, and the liquidation value of the firm is denoted by $V^L = \gamma V^R$. The set of feasible allocations depends on whether the firm is being reorganized or liquidated. Thus, the set of feasible allocations is given by

$$X^R = \left\{(x_s, x_u, x_e) \in I\!R^3 : x_i \geq 0, x_s + x_u + x_e \leq V^R\right\}$$

if the firm is to be reorganized, and by

$$X^L = \left\{(x_s, x_u, x_e) \in I\!R^3 : x_i \geq 0, x_s + x_u + x_e \leq V^L\right\}$$

[8] Prior to 2005, this exclusive right to propose a plan was often extended beyond the first four months by the court. Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 forbids the extension of debtor's exclusivity period beyond 18 months.

[9] The court can also dismiss the case from the bankruptcy proceedings altogether, in which case state collection laws apply. This is relatively rare.

[10] Note that the players can decide to liquidate the firm without converting the case to Chapter 7, and offer an allocation that differs from v^L defined below.

[11] When the firm is deeply insolvent, equityholders may not be part of the negotiations since verifying that the equityholders are not entitled to anything under absolute priority rule is almost costless. In the empirical implementation of the model, I allow for this possibility. I do so by making $\pi = (\pi_s, \pi_u, \pi_e)$ a function of the solvency of the firm as well as relative size of secured and unsecured debt owed to the creditors. In order to keep the bargaining model focused, I delay specifying functional forms for the parameters until Section 5.

if the firm is to be liquidated. For any allocation $x \in X^R \cup X^L$, x_i is the disbursement to player i. The present discounted utility for player i resulting from receiving x_i in period t is $\beta^t x_i$ where $\beta \in (0, 1)$.

Whenever agreement is not reached, there is a chance that the case is converted to Chapter 7 at the beginning of the next period. I denote the probability of continuing bargaining at any period (conditional on having reached that period) by q. If the case is converted to Chapter 7, then there is liquidation and the players receive their liquidation payoffs according to the absolute priority rule: The proceeds are used to pay the secured creditors first, unsecured creditors next, and equityholders last. That is, player s receives $v_s^L = \min\{V^L, D_s\}$, player u receives $v_u^L = \min\{\max\{V^L - D_s, 0\}, D_u\}$, and player e receives $v_e^L = \max\{V^L - D_s - D_u, 0\}$. Notice that, for any given V^L, the liquidation payoff is strictly increasing in γ for precisely one of the players, and is constant in γ for the other two players.

The game is played as follows: At date 0, player i is selected as the proposer with probability π_i. The proposer chooses a proposal that specifies what to do with the firm $\mu \in \{R, L\}$ where R denotes reorganization and L denotes liquidation, together with an allocation in X^μ. The other players respond by either accepting or rejecting the proposal. If both of the other players accept the proposal, the game ends and the proposal is implemented. If an agreement is not reached, then the process moves into date 1 with probability q. With probability $1 - q$, bargaining breaks down, the case is converted to Chapter 7, and players receive their liquidation allocation $v^L = [v_s^L, v_u^L, v_e^L]$. The bargaining process continues until either an agreement is reached or the case is converted to Chapter 7.

An outcome of this game is a pair $(\hat{\mu}, \hat{x})$ where $\hat{\mu} \in \{R, L\}$ denotes the fate of the firm (i.e., reorganization or liquidation) and $\hat{x} \in X^{\hat{\mu}}$ is the agreed upon allocation. A history is a sequence of realized proposers and actions taken up to that point. A strategy for player i specifies his intended action (what to propose and how to vote) as a function of the history. A strategy profile is a tuple of strategies, one for each player. A strategy profile is subgame perfect (SP) if, at every history, it is a best response to itself. An SP outcome and payoff are the outcome and payoff functions generated by an SP strategy profile. A strategy profile is stationary if the actions prescribed at any history depend only on the current level of surplus, proposer and offer. A stationary subgame perfect (SSP) outcome and payoff are the outcome and payoff generated by an SSP strategy profile.[12]

Several remarks are in order to motivate the assumptions I make in specifying the set of players. First, there is no judge in the model. There are several ways the bankruptcy court can influence the outcome of bargaining: appointment of trustee, extension or lifting of the exclusivity period, setting deadlines, etc. However, in practice, despite the powers they have, the bankruptcy judges play

[12] It is well know that in multilateral bargaining games like the one considered here, if players are sufficiently patient, then any allocation of the surplus can be sustained as a subgame perfect equilibrium payoff regardless of the agreement rule (see, e.g., Baron and Ferejohn, 1989; Merlo and Wilson, 1995). Stationarity, on the other hand, typically selects a unique equilibrium (see, e.g., Baron and Ferejohn, 1989; Merlo and Wilson, 1995; Eraslan, 2002). Like these papers, I restrict attention to stationary subgame perfect equilibria.

insignificant roles in large bankruptcy reorganizations, which represents the focus of this study.[13]

Second, I do not model the management as a separate negotiating party. The goal of the negotiations in Chapter 11 is to divide the value of the firm among the creditors and equityholders (along with deciding what to do with the firm) in return for cancellation of their prebankruptcy claims against the firm. Unless the management has stock holdings of its own, the only way it can obtain an allocation for itself is through the design of an excessive compensation package. However, as LoPucki and Whitford (1993) point out, the creditors and equityholders are able to control management excesses through the legal process.[14]

Alternatively, one might believe that management is aligned with the equityholders and negotiate solely on their behalf. This is not necessarily the case because managers of insolvent firms owe a fiduciary duty to both the creditors and the equityholders. In addition, management turnover is quite large during reorganizations, and a significant number of the changes are initiated by the creditors,[15] which may result in hiring of CEOs that are more aligned with the creditors. One possibility is to extend the model to explain not only the division of the surplus among the claimants, but also to explain an additional observable characteristics (such as management turnover). It may then be possible to identify whether the management will side with the creditors or the equityholders using the additional data. Due to lack of data on additional observable characteristics, I leave such an extension for future work.

3.2. *Characterization of Stationary Subgame Perfect Equilibria.* In this section, I characterize the set of SSP payoffs. Let v_i denote the SSP payoff of player i. Conditional on no breakdown, the subgame starting at any date is identical to the game starting at date 0. This implies that v_i is equal to the expected payoff of player i from the subgame starting next period discounted back to the current period. I will also refer to v_i as the continuation payoff of player i. Let x_i^κ denote the share of the firm value awarded to player i under the equilibrium proposal when the proposer is κ. Since v_i is the continuation payoff of player i, it must satisfy $v_i = \beta q \sum_\kappa \pi_\kappa x_i^\kappa + \beta(1-q)v_i^L$. In order to characterize the equilibrium payoffs, I need to describe the equilibrium strategies that determine x_i^κ.

First note that the proposer will propose to liquidate the firm if $V^L > V^R$ and to reorganize the firm if $V^L \leq V^R$ since it results in a larger cake to be divided among the claimants,[16] Thus $\mu = L$ if $V^L > V^R$ and $\mu = R$ if $V^L \leq V^R$, and the value of the firm under the chosen alternative is $V = \max\{V^R, V^L\}$. Now consider an SSP

[13] Based on interviews with bankruptcy attorneys, LoPucki and Whitford (1993) conclude that judicial restraint seems to be the norm in large bankruptcies.

[14] In addition, Gilson and Vetsuypens (1993) show that about one third of the CEOs are replaced and those who stay experience large reduction in their salaries and bonuses.

[15] See e.g., Gilson (1989), (1990), LoPucki and Whitford (1993), and Betker (1995).

[16] The proposer is indifferent between reorganizing and liquidating when $V^R = V^L$. For conciseness, I assume that the proposer proposes to reorganize when indifferent, but this assumption does not affect the equilibrium payoffs.

response to a proposal $x \in X^{\mu}$. Player i votes for the proposal if $x_i \geq v_i$ and votes against it if $x_i < v_i$.[17] Thus, to induce acceptance by player i, a payoff maximizing proposer κ must offer player i a share equal to $x_i^{\kappa} = v_i$, and keep $x_{\kappa}^{\kappa} = V - \sum_{i \neq \kappa} v_i$ for himself. It follows that

$$(1) \qquad v_i = \beta q \left(\pi_i \left(V - \sum_{j \neq i} v_j \right) + (1 - \pi_i) v_i \right) + \beta(1 - q) v_i^L$$

for all i. Note that a deviation by player i from the strategies above at a single date does not affect the continuation payoffs. As a result, when a player is the proposer, he cannot gain by offering a smaller share to at least one of the other players because it would be rejected. Obviously he is not better off by offering a larger share either. Similarly the nonproposing players cannot gain by deviating from the strategies specified above at a single date, and conforming to it thereafter. Thus by the one stage deviation principle for infinite horizon games (see theorem 4.2 in Fudenberg and Tirole, 1991), v_i satisfies Equation (1) if and only if it is an SSP equilibrium payoff. This completes the characterization of the equilibrium payoffs.

For this game, it is possible to explicitly solve for the payoffs. Summing (1) over all i, I obtain $\sum_i v_i = \beta(qV + (1 - q)V^L)$. Substituting back in (1) for $\sum_{j \neq i} v_j$, I obtain

$$v_i = \beta q(\pi_i G + v_i) + \beta(1 - q) v_i^L,$$

where $G = V - \beta\ (qV + (1 - q)V^L) = V(1 - \beta(q + (1 - q) \min\{\gamma, 1\}))$ is the gain from proposing. Rearranging yields

$$(2) \qquad v_i = \frac{\beta\big(q\pi_i G + (1 - q) v_i^L\big)}{1 - \beta q}.$$

In equilibrium, the proposer κ receives $G + v_{\kappa}$ and player $i \neq \kappa$ receives v_i. Notice that the allocation to all players depend on the same set of parameters. In other words, a single parameter vector generates an internally consistent set of equations that describe the allocation vector that would be agreed upon in equilibrium.

Since the focus of this article is on estimating the liquidation value parameter γ, it is useful to briefly discuss its effect on the equilibrium payoffs. As mentioned earlier, for any given V^L, the liquidation payoff of player i given by v_i^L is strictly increasing in γ for precisely one of the players, and is constant in γ for the other players. Let $i^*(\gamma)$ denote this player. When γ is around 1, typically $i^*(\gamma) = u$ since most firms are insolvent but their reorganization value exceeds the secured claims against them.

[17] Note that when indifferent, player i votes for the proposal. Otherwise, the proposer can offer $v_i + \epsilon$ where ϵ is arbitrarily small. For the proposer's problem to have a solution, it must be the case that player i accepts when indifferent. Also, note that with at least three players, there is another equilibrium in which all proposals are rejected. I ignore this trivial equilibrium.

If $\gamma > 1$, then the proposer's gain $G = V^L(1 - \beta) = \gamma V^R(1 - \beta)$ is strictly increasing in γ. Consequently, since v_i^L is also weakly increasing in γ, all players are strictly better off as γ increases. Suppose now $\gamma < 1$ so that the reorganization value exceeds the liquidation value. In this case, the proposer's gain $G = V^R(1 - \beta(q + (1 - q)\gamma))$ is strictly decreasing in γ. If $i \neq i^*(\gamma)$, then v_i^L is constant in γ, and hence an increase in liquidation value lowers player i's expected payoff v_i. For player $i^*(\gamma)$, there are two opposing effects of increasing γ when $\gamma < 1$. On the one hand, an increase in γ decreases the gain from proposing whenever he is proposer. On the other hand his liquidation payoff is strictly higher. It is straightforward to verify that the latter effect dominates, and thus player $i^*(\gamma)$ is always better off as γ increases.

4. DATA

The data I use contains information on 128 large, publicly held firms that filed for Chapter 11 between 1990 and 1997, and had a confirmed plan by the end of 2000. The initial sample of companies is obtained from Lynn LoPucki's database available at www.lopucki.com. This database includes all Chapter 11 bankruptcies with assets of at least $100 million in 1980 dollars at the time of bankruptcy filing, and had at least one security registered with the Securities and Exchange Commission (SEC). For each firm in the sample, I obtained the case number and information on the bankruptcy court that handled the case from Public Access to Court Electronic Records (PACER), and tracked the disposition of the case (whether it is confirmed, dismissed, or converted) from LEXIS-NEXIS, BankruptcyData.com, and Factiva. Once a case is confirmed, I obtained the confirmation order from the corresponding bankruptcy court if the case was still in the court.[18] I used the confirmation order to identify the confirmed plan and the associated disclosure statement. I then contacted the court again to obtain these documents. For some firms, I was able to obtain the reorganization plans and/or the disclosure statement from 10K or 8K filings with SEC or from the lawyers who were involved with the case. Additionally Lynn LoPucki kindly shared his collection of these documents. The firms are then matched with corresponding price data from CRSP database, financial data from Compustat database, as well as with their 10K filings.

From an initial sample of 183 firms, a subsample was selected to meet some additional criteria. First, I excluded the cases without a confirmed plan since my model has predictions only with respect to confirmed cases. There were 16 such cases. Of these 2 were dismissed, 11 were converted to Chapter 7, and the disposition could not be determined for 3. Second, 12 bankruptcies were excluded because their reorganization plans and the disclosure statements were missing. Third, 13 were eliminated because they were not in the Compustat database. Another 14 were excluded because they lacked financial data within 2 years prior to the bankruptcy

[18] If the case was archived, I obtained the archive locator information from the court, and the rest of the document retrieval was from the regional National Archive Facility that stored the corresponding courts documents.

filing. Altogether these criteria resulted in a sample of 128 corporations that filed for bankruptcy between 1990 and 1997.

For each firm with a confirmed plan, I collected information on the fate of the firm from the reorganization plans. Of the 128 firms in the sample, 17 liquidated and 111 reorganized under the confirmed plan. For 75 firms, I had sufficient information to quantify the agreed upon allocations.[19] The payments in a Chapter 11 reorganization are typically made using a mix of different types of securities (e.g., stocks, bonds) as well as cash. Therefore, a valuation of these securities is necessary to quantify the accepted allocations. For stocks, I used the first available prices following emergence from bankruptcy. The prices were obtained from CRSP, 10Ks, and pcquote.com. Debt is valued at face. Warrants are valued using Black-Scholes formula (adjusted for dilution effect of warrant exercise). For 35 firms, I was also able to identify the proposer of the plan. Of these 35 firms, unsecured creditors were the proposer in 29 cases, secured creditors were the proposer in 2 cases, and the equityholders were the proposer in the remaining 4 cases.

In order to control for variables that may influence the parameters of the model, I collected additional information about each firm based on the existing theoretical and empirical research on the determinants of the liquidation value. Williamson (1988) stresses the link between the specificity of assets and their liquidation value. In particular, he argues that firms with more industry specific assets have lower redeployability, and thus lower liquidation values. Shleifer and Vishny (1992) present a model in which the highest value users of a firm asset are the other firms in the same industry. In their model, when a firm in financial distress needs to sell its assets, others firms in the same industry are likely to be experiencing problems as well. This in turn implies that liquidation values decrease during industry downturns. To proxy for the asset specificity, I follow the existing literature and use research and development as a fraction of sales (RESDEV) and intangibles as a fraction of total assets (INTANG) as control variables.[20] Both of these variables are computed using the last available financial statement in the last two years before bankruptcy filing. Also following Strömberg (2000), I classify the assets into three groups depending on specificity: specific assets, nonspecific assets, and intermediary assets, and compute fraction of specific and nonspecific assets (SPEC and NONSPEC, respectively). As in Strömberg (2000), specific assets include machinery and equipment and nonspecific assets include cash and marketable securities, land, and buildings. Many firms in my sample lacked information to compute SPEC and NONSPEC at the firm level; therefore I use the industry median instead. To account for the overall industry condition, I compute the fraction of the firms in the industry that had interest coverage less than one during the year of firm's bankruptcy filing, and denote this quantity by FRACDIST. All industry

[19] For some firms, the total claims of one or more creditor classes was missing. When that is the case, the bargaining model is unable to generate any prediction with respect to the allocation due to lack of exogenous data. For another group of firms, information about the price of the securities that were distributed could not be obtained.

[20] Intangibles are assets that have no physical existence in themselves, but represent rights to enjoy some privilege such as client lists, contract rights, copyrights goodwill, copyrights, formulae, franchises, goodwill, licenses, patents, and trademarks.

related variables are computed at the four digit SIC code level. Finally, I control for the overall macroeconomic condition at the time of the bankruptcy filing using the real interest rate (REALINT). Since recessions are often preceded by sharp increases in real interest rates, a higher real interest rate proxies for worse macroeconomic conditions (see Hall, 1999, for a model in which higher real interest rates result in liquidation and job destruction). I compute the real interest rate as the difference between the 3-month T-bill rate and the realized inflation rate in the month of firm's bankruptcy filing.

I also entertain the possibility that the discount factors may differ across firms. For example, firms that file for prepackaged bankruptcy[21] may have lower discount factors. I let the dummy variable PREPACK take the value one if the bankruptcy is prepackaged, and zero otherwise. In addition, there could be differences in the speed with which the courts handle cases. If that is the case, the discount factors may be lower at slower courts.[22] It is well known that Delaware and Southern District of New York bankruptcy courts behave differently than other courts, and in particular, there is some evidence that they tend to be speedier (see, e.g., Ayotte and Skeel, 2004). I let the dummy variable DELNY take the value one if the firm's bankruptcy was filed either in Delaware or Southern District of New York, and zero otherwise.

Descriptive statistics of all the variables are reported in Table 1 where FATE is a dummy variable that takes the value one if the firm reorganized, and zero if it is liquidated; SECPROP is a dummy variable that takes the value one if the secured creditors were the proposer, and zero otherwise; UNSECPROP is a dummy variable that takes the value one if the unsecured creditors were the proposer and zero otherwise; and EQPROP is a dummy variable that takes the value one if the equityholders were the proposer and zero otherwise.

5. ECONOMETRIC SPECIFICATION

Given the vector of parameters (β, γ, π, q), firm value V and creditor claims $D = (D_s, D_u)$, the model described in Section 3 generates a probability distribution for the following endogenous variables: the identity of the proposer κ, the fate of the firm given by the choice μ (i.e., whether the firm is reorganized or liquidated), and the accepted proposal $x^\kappa = (x_1^\kappa, x_2^\kappa, x_3^\kappa)$. Specifically, I have $\kappa = i$ with probability π_i,

$$\mu(\beta, \gamma, \pi, q, D) = \begin{cases} R & \text{if } \gamma \leq 1 \\ L & \text{if } \gamma > 1, \end{cases} \tag{3}$$

[21] In a prepackaged bankruptcy, the reorganization plan is negotiated outside the bankruptcy. Once the firm files for bankruptcy, it already has an agreed upon plan and the role of the court is to formally collect the votes and to confirm the plan.

[22] On the other hand, the firms have some ability choose the venue of their bankruptcy. One might argue that more impatient firms file at speedier courts. Overall this self-selection combined with the corresponding speed of court would result in roughly constant discount factors.

TABLE 1
DESCRIPTIVE STATISTICS

	Mean	Standard Deviation	Minimum	Maximum
FATE	0.13	0.34	0	1
SECPROP	0.06	0.24	0	1
UNSECPROP	0.83	0.38	0	1
EQPROP	0.11	0.32	0	1
Firm value (V) (million $)	565.58	824.17	39.56	5454.14
Allocation to secured (million $)	244.56	441.68	0.00	2893.79
Allocation to unsecured (million $)	271.41	437.65	3.15	3400.00
Allocation to equity (million $)	49.61	243.88	0.00	2054.14
Allocation to secured/Firm value	42.12%	28.99%	0.00%	94.36%
Allocation to unsecured/Firm value	51.97%	28.61%	0.67%	100.00%
Allocation to equity/Firm value	5.90%	11.73%	0.00%	73.00%
Secured claims (million $)	252.66	420.18	0.00	2543.88
Unsecured claims (million $)	534.44	662.73	3.15	3384.30
Secured claims/Firm value	45.83%	33.67%	0.00%	132.36%
Unsecured claims/Firm value	122.24%	103.69%	0.67%	613.36%
RESDEV	0.40%	1.49%	0.00%	11.55%
INTANG	8.55%	13.62%	0.00%	59.73%
SPEC	14.64%	13.07%	0.00%	59.27%
NONSPEC	21.62%	16.87%	0.00%	67.47%
FRACDIST	26.85%	17.25%	0.00%	83.33%
REALINT	1.38%	1.10%	−0.36%	3.38%
PREPACK	0.11	0.31	0.00	1.00
DELNY	0.46	0.50	0.00	1.00

$$(4)\qquad x_j^{\kappa}(\beta,\gamma,\pi,q,D)=\begin{cases} v_j(\beta,\gamma,\pi,q,D) & \text{if } j\neq\kappa \\ G(\beta,\gamma,\pi,q,D)+v_j(\beta,\gamma,\pi,q,D) & \text{if } j=\kappa, \end{cases}$$

where

$$G(\beta,\gamma,\pi,q,D)=V\left(1-\beta\left(q+(1-q)\min\{\gamma,1\}\right)\right),$$

and

$$v_i(\beta,\gamma,\pi,q,D)=\frac{\beta\big(q\pi_i G(\beta,\gamma,\pi,q,D)+(1-q)v_i^L(\beta,\gamma,\pi,q,D)\big)}{1-\beta q}.$$

From the perspective of the players, the choice μ and allocation x^{κ} are deterministic conditional on κ. I (the econometrician), however, do not know all the components of the information set of the players. Hence, from the perspective of the econometrician, μ and x^{κ} are random variables even conditional on κ. Let $Z = (V, D_s, D_u, RESDEV, INTANG, SPEC, NONSPEC, FRACDIST, REALINT, PREPACK, DELNY)$ denote the set of exogenous variables, and let $F_{\gamma}(\gamma \mid Z)$ and $f_{\gamma}(\gamma \mid Z)$, respectively, denote the distribution and density of the liquidation value conditional on the exogenous variables Z. Thus, from the perspective of the econometrician, the probability that the firm is reorganized is given by

$$\Pr(\mu = R) = F_\gamma(1 \mid Z) \tag{5}$$

and the probability that the firm is liquidated is given by

$$\Pr(\mu = L) = 1 - F_\gamma(1 \mid Z). \tag{6}$$

When the firm is so insolvent it is straightforward to invoke cram-down by convincing the judge that equityholders would not get anything under the absolute priority rule. To allow for this possibility, with some probability δ, equityholders are left out of the game and the negotiations proceed between the secured and unsecured creditors. Specifically, I assume that $\delta = \delta(D, V)$ where

$$\delta(D, V) = \frac{\exp\left(\delta_0 + \delta_1 \frac{D_s + D_u}{V}\right)}{1 + \exp\left(\delta_0 + \delta_1 \frac{D_s + D_u}{V}\right)}. \tag{7}$$

Next I need to specify the proposer probabilities. Obviously, the proposer selection probabilities depend on the number and the identity of the players in the bargaining. I also allow them to depend on the size of secured and unsecured debt claims. Let $E = 1$ denote the event that equityholders are part of the negotiations, and $E = 0$ denote the event that equityholders are left out of the negotiations. As mentioned above, if $D_i = 0$ for $i = s, u$, then i is not part of the negotiations. I assume that

$$\pi_e = \pi_e(E, D, V) = \begin{cases} 0 & \text{if } E = 0 \\ \dfrac{\exp\left(\alpha_0^e + \alpha_1^e \frac{D_s}{V} + \alpha_2^e \frac{D_u}{V}\right)}{1 + \exp\left(\alpha_0^e + \alpha_1^e \frac{D_s}{V} + \alpha_2^e \frac{D_u}{V}\right)} & \text{if } E = 1, \end{cases} \tag{8}$$

(9)

$$\pi_s = \pi_s(E, D, V) = \begin{cases} 0 & \text{if } D_s = 0 \\ 1 - \pi_e & \text{if } D_s > 0 \text{ and } D_u = 0 \\ (1 - \pi_e) \dfrac{\exp\left(\alpha_0^s + \alpha_1^s \frac{D_s}{V} + \alpha_2^s \frac{D_u}{V}\right)}{1 + \exp\left(\alpha_0^s + \alpha_1 \frac{D_s}{V} + \alpha_2^s \frac{D_u}{V}\right)} & \text{if } D_s > 0 \text{ and } D_u > 0. \end{cases}$$

Of course, once π_e and π_s are specified, π_u is residually specified by the identity

$$\pi_u(E, D, V) = 1 - \pi_e(E, D, V) - \pi_s(E, D, V).$$

To reduce the influence of outliers, I assume that the allocations are observed with error. To minimize the number of error terms needed, I assume that the total firm value (i.e., the reorganization value, if the firm is reorganized and the liquidation value, if the firm is liquidated) is observed correctly, but the split of the surplus is observed with error. This assumption can be justified, for example, by the fact that some individuals may be in multiple claimant classes.[23]

Specifically, I assume that, conditional on the true allocation vector (normalized by the firm value) being x^κ, I observe the allocation vector (normalized by the firm value) y from a Dirichlet distribution with parameter Hx^κ, and so the density of y is given by

$$f_y(y \mid x^\kappa, H) = \frac{1}{B(Hx^\kappa)} \Pi_{i=1}^n y_i^{Hx_i^\kappa - 1},$$

where n is the dimension of x^κ and y (i.e., the number of players), and $B(Hx^\kappa)$ denotes the normalizing constant for Dirichlet distribution with parameter Hx^κ. That is,

$$B(Hx^\kappa) = \frac{\Pi_{i=1}^n \Gamma\left(Hx_i^\kappa\right)}{\Gamma\left(\sum_{i=1}^n Hx_i^\kappa\right)}.$$

Note that

$$E\big(y_i \mid x^\kappa, H\big) = x_i^\kappa,$$

and

$$\mathrm{Var}\big(y_i \mid x^\kappa, H\big) = \frac{x_i^\kappa\left(1 - x_i^\kappa\right)}{H^2(H+1)},$$

so for H large enough the measurement error is small.

I now derive the likelihood function that represents the basis for the estimation of the structural model. For use below, I let the set K denote the set of proposers, which is equal to set of all players when the identity of the proposer is not observed, and is singleton containing the identity of the proposer when it is observed. The contribution of each observation in the sample to the likelihood function is equal to the probability of observing the vector of endogenous events (K, μ, E, y) conditional on the exogenous characteristics Z, given the vector of parameters $\theta = (\alpha_0^e, \alpha_1^e, \alpha_2^e, \alpha_0^s, \alpha_1^s, \alpha_2^s, \beta, \delta_0, \delta_1, F_\gamma, H, q)$. Given the structure of the model and the equilibrium characterization, this probability can be written as

(10)
$$\Pr(K, \mu, E, y \mid Z; \theta) = \sum_{\kappa \in K} \Pr(E \mid Z; \theta) \Pr(\kappa \mid E, Z; \theta) \Pr(\mu \mid Z; \theta) \Pr(y \mid \mu, \kappa, Z; \theta),$$

[23] This could be the case if vulture investors diversify their portfolio by purchasing claims in different classes so that their exposure is limited if a particular class does not receive a favorable treatment. For example, Oaktree Capital, which is one of the biggest players in the vulture market, uses such a strategy on a systematic basis.

where

$$\Pr(E = 1 \mid Z;\theta) = 1 - \delta(D, V), \quad \Pr(E = 0 \mid Z;\theta) = \delta(D, V), \tag{11}$$

$$\Pr(\kappa \mid E, Z;\theta) = \pi_\kappa(E, D, V) \tag{12}$$

$$\Pr(\mu = R \mid Z;\theta) = F_\gamma(1 \mid Z;\theta), \quad \Pr(\mu = L) = 1 - F_\gamma(1 \mid Z;\theta), \tag{13}$$

$$\Pr(y \mid \mu = R, \kappa, Z;\theta) = \frac{\int_{\gamma \leq 1} f_y(y \mid x^\kappa(\gamma))\, dF_\gamma(\gamma \mid Z;\theta))}{F_\gamma(1 \mid Z;\theta)}, \tag{14}$$

$$\Pr(y \mid \mu = L, \kappa, Z;\theta) = \frac{\int_{\gamma > 1} f_y(y \mid x^\kappa(\gamma))\, dF_\gamma(\gamma \mid Z;\theta)}{1 - F_\gamma(1 \mid Z;\theta)}, \tag{15}$$

where (suppressing its other arguments) $x^\kappa(\gamma)$ is given by (4). For some firms, I only observe the fate of the firm μ. The contribution to the likelihood of these observations is given by $\Pr(\mu \mid Z;\theta)$. The log-likelihood function is obtained by summing the logs of (10) over all the elements in the sample for which I have information on the allocation y and the log of $\Pr(\mu \mid Z;\theta)$ over all the elements in the sample for which the only information I have is the fate of the firm μ. The next step consists of choosing a parametric functional form for $F_\gamma(\gamma \mid Z; \theta)$. Since $\gamma \geq 0$ by definition, I assume that γ is lognormally distributed. In particular, I let

$$\log(\gamma) = \log(\gamma_0 + \gamma_1 FRACDIST + \gamma_2 REALINT + \gamma_3 RESDEV + \gamma_4 INTANG + \gamma_5 SPEC + \gamma_6 NONSPEC) + \epsilon, \tag{16}$$

where $\epsilon \sim N(0, \sigma_\gamma^2)$. Furthermore, I let

$$\beta = \frac{\exp(\beta_0 + \beta_1 PREPACK + \beta_2 DELNY)}{\exp(\beta_0 + \beta_1 PREPACK + \beta_2 DELNY) + 1}. \tag{17}$$

6. RESULTS

Table 2 presents the maximum likelihood estimates of the model $(\alpha^s, \alpha^e, \beta_0, \beta, \delta, \Gamma, H, \sigma_\gamma, q)$ where $\alpha^i = (\alpha_0^i, \alpha_1^i, \alpha_2^i)$ for $i = s, e, \beta = (\beta_0, \beta_1, \beta_2), \delta = (\delta_0, \delta_1)$ and $\Gamma = (\gamma_0, \ldots, \gamma_6)$.

An inspection of Table 2 shows that except for the coefficient of nonspecific assets, the sign of the parameters conform to priors. Liquidation value relative to reorganization value is higher when the industry conditions are favorable ($\gamma_1 < 0$), the real interest rates are higher ($\gamma_2 > 0$), research and development expenses are lower ($\gamma_3 < 0$), fraction of intangibles are lower ($\gamma_4 < 0$), and fraction

TABLE 2
MAXIMUM LIKELIHOOD ESTIMATES

	Estimate	Standard Error
α_0^s	−2.205	0.902
α_1^s	4.141	0.988
α_2^s	−2.459	0.583
α_0^e	0.917	0.501
α_1^e	−2.245	0.494
α_2^e	−1.909	0.390
β_0	24.238	14.202
β_1	−0.893	0.626
β_2	0.657	0.765
δ_0	−3.525	0.783
δ_1	1.368	0.401
γ_0	−0.144	0.080
γ_1	−0.340	0.167
γ_2	4.832	2.458
γ_3	−1.635	2.590
γ_4	−0.286	0.191
γ_5	−0.110	0.196
γ_6	−0.051	0.163
H	93.081	21.325
σ_γ	0.2210	0.0315
q	0.927	0.245
Log-Likelihood	131.29	

of firm specific assets are lower ($\gamma_5 < 0$). One would also expect the liquidation value relative to reorganization value to be higher when the fraction of nonspecific assets is higher. However, the parameter estimate for γ_6 is negative although it is not statistically significant. In fact, except for the coefficients of industry and macroeconomic conditions, the coefficients of the variables describing the distribution of γ are all insignificant. Likewise, the coefficients for the variables that describe the discount factor are not significant even though they have the expected signs: The discount factors are higher in bankruptcies that are not prepackaged ($\beta_1 < 0$) and filed in Delaware or Southern District of New York ($\beta_2 > 0$).

As one would expect, the proposer selection probability of the secured creditors (relative to the proposer selection probability of the unsecured creditors) depends on the relative composition of the secured and unsecured debt. In particular, holding δ and π_e fixed, the secured creditors are more likely to be selected as the proposer when the secured claims are higher ($\alpha_1^s > 0$) and the unsecured claims are lower ($\alpha_2^s < 0$). On the other hand, the proposer selection probability for the equityholders is lower both when the secured claims are higher ($\alpha_1^e < 0$) and when the unsecured claims are higher ($\alpha_2^e < 0$). Furthermore, the parameter estimates for α_1^e and α_2^e are not statistically different from each other. This is reasonable: The equityholders' bargaining power depends only on the total debt, but not on how it is composed.

The estimate of β is 0.94 with a standard error of 0.224.[24] This implies that the cost of staying in Chapter 11 is on the average 6% of the firm value per period. Existing studies that estimate the costs of bankruptcy distinguish between the direct costs and the indirect costs but do not distinguish between variable (per period) and fixed costs (see, e.g., Altman, 1984; Weiss, 1990; Andrade and Kaplan, 1998; Cutler and Summers, 1988). Direct costs are the payments that the firm needs to make to third parties as a result of bankruptcy such as lawyers' fees, investment banking fees, etc. The studies mentioned above estimate these costs to be 3–4% of the prebankruptcy firm value. The indirect costs are the losses due to decreased productivity, lost customers, cancelled shipments, etc., and is harder to measure. The studies mentioned above estimate the indirect costs to be on the average 10–17% of the prebankruptcy firm value. One would expect that the direct costs are incurred largely per period. On the other hand, it seems likely that most of the indirect costs are incurred at the time of the bankruptcy news, but do not vary much by the subsequent stay in bankruptcy.[25] As such, the discount factor is better interpreted as a direct cost. The estimate of the mean bankruptcy cost is rather large compared to existing estimates of bankruptcy costs.[26] It should be noted, however, that the asymptotic distribution of the discount factor is skewed to the left, so the mean bankruptcy cost estimate of 6% per period represents an upper bound.

Equityholders are more likely to be excluded from the negotiations for less solvent firms ($\delta_1 > 0$). The estimates imply that equityholders are left out of the negotiations, and therefore, receive nothing in 25.33% of the cases.[27] This is precisely what I observe in the data.

More generally, the model fits the data well in other dimensions as well. To assess the fit of the model, I present Tables 3–7. In each of these tables, I focus on a different dimension of the data, and I compare the predictions of the model to the empirical distribution. For each dimension of the data, I use Pearson's χ^2 test,

$$N \sum_{j=1}^{J} \frac{[f(j) - \hat{f}(j)]^2}{\hat{f}(j)} \sim \chi^2_{J-1}$$

to assess the fit of the model, where $f(.)$ denotes the empirical density function (histogram) of a given endogenous variable, $\hat{f}(.)$ denotes the maximum likelihood

[24] This is obtained by drawing 1,000 β_0's, computing β using Equation (17) and then computing the mean and standard deviation of β over all the draws.

[25] An example of this is the airlines that operate in bankruptcy currently. Many customers were aware of the bankruptcy while the news was still fresh, and coverage in the media was high, but their awareness dissipated over time as the airlines stayed in bankruptcy.

[26] Existing studies look at a mix of large and small firms, and their estimates are typically much smaller for larger firms. Also, as mentioned above, the estimated 3% to 4% is an estimate of the direct costs during the entire duration of bankruptcy, which is on the average 2 years, whereas mine is a per period estimate.

[27] Note that whether the equityholders are part of the negotiations or not (i.e., $E = 0$ or $E = 1$) is exogenous and random.

TABLE 3
DENSITY FUNCTION OF FATE OF THE FIRM

Fate of the Firm	Data		Model
Reorganization	0.867		0.829
Liquidation	0.133		0.172
χ^2 test		1.390	
$\Pr(\chi^2(1) \geq 1.490)$		0.499	

TABLE 4
DENSITY FUNCTION OF PROPOSER

Proposer	Data		Model
Secured creditors	6%		12%
Unsecured creditors	83%		74%
Equityholders	11%		13%
χ^2 test		1.721	
$\Pr(\chi^2(2) \geq 1.549)$		0.423	

TABLE 5
DENSITY FUNCTION OF ALLOCATION TO SECURED CREDITORS AS A FRACTION OF FIRM VALUE

Interval	Data		Model
0%–15%	19%		19%
15%–30%	13%		13%
30%–45%	19%		16%
45%–60%	13%		18%
60%–75%	17%		17%
75%+	19%		18%
Mean Allocation to Secured Creditors/Firm Value	46%		46%
χ^2 test		1.375	
$\Pr(\chi^2(5) \geq 1.442)$		0.927	

estimate of the density function of that variable, N is the number of observations, and J is the number of bins of the histogram.

In Table 3, I compare the density of the fate of the firm predicted by the model to the empirical density. Table 4 reports evidence on the fit of the model to the distribution of proposers. In Tables 5–7, I compare the density of the fraction of the firm value received by secured creditors, unsecured creditors, and equityholders, respectively.[28] As can be seen from these tables, the model is capable of reproducing

[28] Note that the means of the fraction of the firm value received by secured creditors, unsecured creditors, and equityholders need not add up to one because different observations can have different number of creditors.

TABLE 6

DENSITY FUNCTION OF ALLOCATION TO UNSECURED CREDITORS AS A FRACTION OF FIRM VALUE

Interval	Data	Model
0%–15%	9%	13%
15%–30%	20%	15%
30%–45%	13%	18%
45%–60%	13%	15%
60%–75%	19%	15%
75%+	25%	24%
Mean Allocation to Unsecured Creditors/Firm Value	52%	52%
χ^2 test	3.675	
$\Pr(\chi^2(5) \geq 3.704)$	0.597	

TABLE 7

DENSITY FUNCTION OF ALLOCATION TO EQUITYHOLDERS AS A FRACTION OF FIRM VALUE

Interval	Data	Model
0%–15%	71%	70%
15%–30%	12%	16%
30%–45%	8%	6%
45%–60%	3%	3%
60%–75%	0%	2%
75%+	7%	5%
Mean Allocation to Equityholders/Firm Value	6%	5%
χ^2 test	3.247	
$\Pr(\chi^2(5) \geq 5.034)$	0.662	

the empirical distribution in each of these dimensions, and χ^2 goodness-of-fit tests reported do not reject the model at conventional significance levels. Furthermore, the predicted means are almost identical to the ones observed in the data.

7. LIQUIDATION VALUE AND COUNTERFACTUALS

Using the estimates, I compute the expected liquidation value relative to reorganization value. To do this, I draw 5,000 samples of parameter values from the (estimated) asymptotic distribution of the vector of model parameters (based on the estimated variance–covariance matrix), obtain an estimate of $E[\gamma \mid Z]$ for each firm in the sample, and then compute the average across all observations. The results in an estimate of 0.8246 with a standard error of 0.026. This estimate implies a sizable cost of liquidation (0.1754) although substantially smaller than Strömberg's (2000) estimates (ranging from 29% to 42%) and closer to the lower end of Pulvino's (1998) estimates (ranging from 14% to 46%).

Recall that in the model the players agree to liquidate the firm when it is optimal to do so. This implies that not all firms are reorganized and the companies that reorganize are expected to have larger liquidation costs. To evaluate the extent of this selection on the liquidation values, I compute the conditional expectations of γ (standard errors in parentheses):

$$E[\gamma \mid Z, \gamma < 1] = 0.7503 \quad (0.0285),$$

and

$$E[\gamma \mid Z, \gamma > 1] = 1.1570 \quad (0.0380).$$

These results indicate that mandatory liquidation of all firms would have large costs on the average.

I should point out however that the model abstracts from ex ante considerations. One such ex ante consideration is the effect of deviations from absolute priority rule that is associated with negotiations in Chapter 11 on the ex ante decisions taken by the equityholders. For example, Bebchuck (2002) shows that such deviations may aggravate the moral hazard problem with respect to project choice and may result in distortions in the investment choice. Since mandatory liquidation ensures that absolute priority rule is adhered to, its ex ante benefits may outweigh the ex post costs. This would be the case if liquidation costs were small enough. The results indicate that not all firms have same liquidation costs.

The standard deviation of γ captures the dispersion in the liquidation costs. The estimates of the unconditional and condition standard deviations are (standard errors in parentheses):

$$\begin{aligned} \text{St. Dev.}\,[\gamma \mid Z] &= 0.1959 \quad (0.0349) \\ \text{St. Dev.}\,[\gamma \mid Z, \gamma < 1] &= 0.1364 \quad (0.0132) \\ \text{St. Dev.}\,[\gamma \mid Z, \gamma > 1] &= 0.1448 \quad (0.0388). \end{aligned}$$

Even among the firms for which reorganization is optimal ($\gamma < 1$), there is enough variation to suggest that the gains from reorganization are small for at least for some firms. For such firms, a mandatory liquidation may be beneficial if the gain in ex ante welfare is sufficiently high. As a result, there may be efficiency gains if one could design the law to selectively treat firms differently (such as the treatment of farmers and airlines in the current bankruptcy law). However, the results also indicate that liquidation costs are determined mainly by industry and macroeconomic conditions, rather than firm specific characteristics. More specifically, the liquidation value relative to reorganization value is higher when the macroeconomic conditions are less favorable (as in Hall, 1999), but the industry conditions are more favorable (as in Shleifer and Vishny, 1992). Consequently, it is difficult to redesign the bankruptcy law for selective treatment of firms based on their expected liquidation costs.

TABLE 8
EFFECT OF MANDATORY LIQUIDATION ON THE ALLOCATIONS

Allocations as Fraction of Firm Value	Baseline	Mandatory Liquidation
Secured creditors	46%	58%
Unsecured creditors	52%	44%
Equityholders	5%	2%

I next use the estimated model to assess the impact of mandatory liquidation on the equilibrium allocation. Table 8 summarizes the result of this policy experiment. As can be seen from this table, under a mandatory liquidation, the secured creditors' share of the firm value increases at the expense of both the unsecured creditors and the equityholders. Notice however that the firm value is lower under liquidation. For the firms for which I have information on the agreed upon allocations, the total liquidation value is \$34.5 billion compared to total reorganization value of \$42.8 billion. As a result, an average of \$100 million would be destroyed under mandatory liquidation. Consequently, even though the secured creditors receive a larger fraction of the firm, they are worse off under mandatory liquidation. In particular, they recover 96% of their claims under mandatory liquidation compared to 100% under the baseline scenario. For the unsecured creditors, the recovery rate reduces from 62% to 40%. Note, however, that the policy experiment cannot be used to evaluate the potential benefits of mandatory liquidation. In particular, if mandatory liquidation provides a relatively speedy resolution of distress, then its benefits may exceed its costs.

8. CONCLUDING REMARKS

In this article, I have used a novel approach to measure the liquidation value through the information contained in the agreed upon allocations in Chapter 11 negotiations. To do so, I developed a multilateral bargaining that captures the influence of liquidation value on the equilibrium allocations, and estimated the bargaining model directly. I used the estimated model to quantify the effect of a mandatory liquidation on the equilibrium allocation.

Throughout the article, my focus has been exclusively on the split of the surplus, and abstracted away from the timing of the agreement. A stochastic bargaining model in which the firm value changes over time can be used to explain the observed variations in the timing of the agreement. One could combine the estimation approach developed in this article with that in Diermeier et al. (2002, 2003) to make use of the information contained in this variation. I leave this extension for future research.

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