The Rodney L. White Center for Financial Research

Corporate Bankruptcy Reorganizations: Estimates from a Bargaining Model

Hulya Eraslan

18-02

The Wharton School
University of Pennsylvania

Corporate Bankruptcy Reorganizations: Estimates from a Bargaining Model

Hülya K. K. Eraslan*
Department of Finance
The Wharton School
University of Pennsylvania
Tel: 215-898-9424
Fax: 215-898-6200
eraslan@wharton.upenn.edu

This version: November 27, 2002

*I thank Daniel Bussell, John Geweke, John Kareken, Kenneth Klee, Lynn LoPucki, Andrew McLennan, Antonio Merlo, Per Strömberg for helpful discussions. I am grateful to Lynn LoPucki providing the data. Financial support 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.

Abstract

In this paper I estimate a bargaining model of Chapter 11 bankruptcies. I use the estimated structural model to conduct policy experiments aimed at evaluating the impact of institutional rules on the creditor recoveries, distribution to shareholders and deviations from absolute priority rule.

1 Introduction

The current U.S. Bankruptcy Code provides provides the outline of a systematic method of dealing with business failures. Under the Code, a bankrupt firm can either liquidate (Chapter 7), or try to reorganize and continue its operations (Chapter 11). If a firm liquidates, the assets of the firm are sold either as a going concern or piecemeal, and the proceeds are distributed to claimants according to a ranking called the *absolute priority rule*.

An important feature of large Chapter 11 bankruptcies is the transfer of wealth among the parties involved. In particular, 80% of the reorganized cases involve deviations from the absolute priority rule ([7], [10], [14], [25], [35]).[1] Most bankruptcy scholars view the deviations from absolute priority rule as undesirable. Moreover, some critics argue that current U.S. bankruptcy law keeps inefficient firms operating and gives an unfair advantage to bankrupt firms compared to their non-bankrupt competitors. Consequently, there is a body of literature calling for reform, or even repeal of the Bankruptcy Code and suggesting alternative recontracting mechanisms ([1], [3], [5], [8], [22], [32]). Despite the richness of this literature, there is no study that tries to quantify the effects of the institutional structure of the Code on the terms of the agreement in Chapter 11 business reorganizations. The purpose of this paper is to take a first step in this direction by developing a game theoretic model of bankruptcy reorganizations and estimating it using U.S. data.

In this paper, I focus on the terms of agreement in corporate bankruptcy reorganizations in the context of a sequential bargaining with complete information[2]. The model I develop differs from standard bargaining models to

[1] I restrict attention to large bankruptcies. There are several reasons to distinguish between large and small bankruptcy cases. First, the applicable legal rules are not the same for small and large bankruptcies. For example, small businesses are subject to less stringent rules on the information that has to be disclosed. Second, there are inherent differences in large and small bankruptcies. For example, a small business is typically entirely owned by the management. Thus, the management's incentives and bargaining power can be significantly different for small and large reorganizations. Third, the empirical literature has shown that the outcome of the negotiations for large and small bankruptcies differ vastly. For example, more than half of small firm Chapter 11 cases fail before confirmation by the court ([36]). This is in contrast to the successful reorganization rate of approximately 80% for large businesses ([10], [35]). This empirical regularity is perhaps the reason that nearly all legislative bills to amend the Bankruptcy Code contain special provisions for small businesses. The bills can be found online at `http://thomas.loc.gov`.

[2] While the management may have superior information about the value of the firm in

take into account the agreement rule as specified in the law. In particular, unlike negotiations in a workout outside bankruptcy, the law allows confirmation of a plan despite the objection of a claimant class under the so called cramdown provision if that class receives a payment that is at least as much as what that class would received under absolute priority rule. This implies that plan proponents would not necessarily try to obtain the consent of all claimant classes, but instead try to maximize their recoveries by potentially invoking cramdown. This in turn affects the reservation payoffs, and therefore the amount of payments that need to be made in order to obtain consent on a plan. The possibility of cramdown is an important feature empirically as well. In a data set of 309 companies, I find that in two thirds of the cases, a plan was confirmed even though at least one class was deemed to reject the plan. This figure underestimates the exact frequency of cramdowns as it does not take into account cramdown on classes that received some distribution, and therefore was allowed to vote but voted against the plan. Furthermore, in all of the cases, at the least one claimant class was paid in full, and therefore was not allowed to vote, and deemed to accept the plan. Again, the possibility of paying off a creditor class in full and not requiring the vote of that class puts a bound on the reservation payoffs, and has to be taken into account in modelling the negotiations in Chapter 11 bankruptcies.

Another feature of the negotiations in Chapter 11 is that, even if a firm files for Chapter 11 in order to reorganize, it may nevertheless end up liquidating either by conversion of the case to Chapter 7, or through a liquidating Chapter 11 plan if the negotiations are not successful. In a larger data set of 373 companies, I find that 20% of the cases are fully liquidated. Again, this is an underestimate of the frequency of liquidations since it does not take into account partial liquidations. As a starting point, I model liquidation event as an exogenous possibility of breakdown of negotiations.

The theoretical and empirical literature in bankruptcy has so far progressed in parallel.[3] Empirical studies are typically concerned with establishing stylized facts outside context of any theoretical model. Theoretical studies typically aim at providing tractable models to explain some of these facts, but in general not suitable for empirical analysis. I try to close this

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.

[3] An exception is Strömberg [34] who develops a model of cash auctions in bankruptcy and estimates the semi-structural model using data on Swedish firms.

gap by estimating the bargaining model using a data set which contains information on 39 large, publicly held firms that filed for Chapter 11 after October 1979 and emerged from bankruptcy before March 15, 1988. To perform the estimation, I use Markov Chain, Monte Carlo simulation methods in a Bayesian framework (see for example, Geweke [16]). One important feature of the estimation approach, is that I estimate the bargaining model directly in the sense that no unobservable error term is incorporated above and beyond the existing parameters of the bargaining model. The only unobservable is the liquidation value of the firm. The fact that liquidation value cannot be negative puts discipline in the parameter space and therefore, the posterior distributions are robust to changes in the prior. This approach has a number of attractive features. First, no additional assumptions beyond those made in the model are needed to carry out inference, because the distributions are exactly those present in the model. Second, it uses all of the information in the model, not just certain moments. Finally, it allows us to interpret important features of the data as equilibrium phenomena.

The studies most closely related to the theoretical part of the paper are Baird and Picker [4], Bebchuck and Chang [6] and Kordana and Posner [24]. For the most part, the goal of existing studies has been explaining the sources of deviations from absolute priority rule, and regardless of the source, the explanation relies on the assumption that the consent of all classes are required in order to confirm a plan. However, once the consent of shareholders are required, there will always be deviations from the absolute priority rule. Consider for a example a firm that is deeply insolvent, and hence shareholders are not entitled to any payment under absolute priority rule. Shareholders would vote against any plan that gives them nothing since they do not lose anything by rejecting the plan. This means in equilibrium there are always deviations from the absolute priority rule. Therefore, existing models are not able to explain 20% of the cases in which shareholders do not receive anything. One contribution of the theoretical part of this paper is to jointly explain the both the deviations from absolute priority rule and the cases where the priority is strictly followed.

This paper also makes a contribution to the estimation of game theoretic models. Although there is a large literature that incorporate bargaining models in applied framework, there are only few studies that bring up these models to data. To my knowledge, the only study that estimates a bargaining model is Sieg[33] who uses generalized method of moments in the context of a finite horizon asymmetric information bargaining model.[4] In this paper, I estimate an infinite horizon, complete information model using a likelihood based approach. As mentioned earlier, the advantage of a likelihood based approach is that one needs to match the whole distribution of the endogenous variables, rather than certain moments.

Empirical analysis indicate that the model fits data well. I use the estimated model to evaluate the effect of various changes in the institutional features. I find that a forced liquidation would decrease the welfare by about 3 cents for each $1 of creditor claims. I also find that the effect of removal of cramdown provisions would not have a significant effect on average distributions to creditors although it would result in a deviation from absolute priority in every case. On the other hand, removal of management's exclusive right to propose a plan would reduce the frequency of deviations from absolute priority to 48% from 80%.

The remainder of the article is organized as follows. Section 2 provides a brief overview of the U.S. Bankruptcy Code. In section 3, I develop the bargaining model to be estimated. Section 4 presents an overview of the data and empirical methods. Finally, in Section 5 I present the results and conclude.

2 A Brief Overview of Chapter 11

In this section I describe the U.S. business bankruptcy procedure.[5] A firm can file for bankruptcy either under Chapter 7 of the Code, in which case the firm is liquidated, or under Chapter 11 of the Code, in which the firm tries to reorganize. Since liquidation sets the framework for bargaining over a reorganization under Chapter 11, I start by describing the liquidation procedure under Chapter 7.

Chapter 7: In a Chapter 7 filing a trustee is appointed to liquidate the firm. He sells the firm's assets either as a going concern or piecemeal. In either event, the proceeds are distributed to claimants according to a ranking called the *absolute priority rule*. The order of payment according to

[4]Remaining few studies that bring a bargaining model up to data, such as Diermeier, Eraslan, and Merlo [9], use the bargaining model to explain features of the data other than the split of the surplus.

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

the absolute priority rule is as follows: first, secured creditors (with respect to the proceeds of their own collateral); second, priority claims which include taxes, bankruptcy costs, such as legal fees, and costs incurred during the bankruptcy to run the business, such as wages; third, unsecured claims, fourth, pendency interest, that is, interest since the filing of the case, in the order above; and fifth, shareholders.

Chapter 11: The Chapter 11 bankruptcy process begins when a petition is filed under Chapter 11 of the Code. Chapter 11 is designed to keep the firm operating and to protect its assets while a reorganization plan (henceforth, plan), the objective of which is to settle the claims of all prebankruptcy creditors, is being negotiated. During this period, an *automatic stay* goes into effect that prevents debt holders from seizing the firm's assets and usually the management stays in control of the firm.

The creditors are grouped into classes according to the types of claims they hold, e.g., secured creditors, unsecured creditors, shareholders, etc.[6] 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. A plan is confirmed if it is feasible, offers full payment to priority classes (unless they agree otherwise), and all classes and individuals accept it. Even if an individual votes against the plan, the plan can be confirmed so long as that individual receives a payment equal to what he would receive in a Chapter 7 liquidation. If a class, as opposed to an individual, rejects the plan, the plan can be confirmed under *cramdown* provisions if the plan satisfies the *fair and equitable* requirement with respect to dissenting classes. A plan is fair and equitable with respect to a class if that receives at least as much as it would under absolute priority rule. Under the fair and equitable test, how much a class would receive absolute priority rule is computed using the reorganization value of the firm.[7]

[6] The number of classes involved in a bankruptcy negotiation is not always the same, but it depends on the nature of the claims against the firm. For example, if there are damage claims against the firm, resulting perhaps from injuries caused by a defective product, the holders of the damage claims can constitute a class. Furthermore, the plan proponents have some flexibility in designating the classes. In particular, while claims that are not similar have to be in separate classes, there is no requirement that similar claims have to be in the same class.

[7] In contrast, *best interest test*, which is aimed at protecting dissenting individuals instead of dissenting classes, compares the payment to an individual to what he would have received under absolute priority rule in liquidation.

If a plan cannot be confirmed, the parties continue negotiating. If no progress is made towards agreement, then the court can decide to convert the case to Chapter 7, or dismiss it from the bankruptcy proceedings altogether, in which case state collection laws apply.

3 Model

Timing and information structure: I consider a discrete time, infinite horizon bargaining game with complete information.

Players: There are two players, s and c, where player s denotes shareholders and player c denotes the creditors. The amount of debt that the firm owes to c is normalized to be 1. Generic players are denoted by i, j. In each period, a player is randomly selected to offer a proposal with a stationary probability. I let π_i denote the probability of being selected as the proposer for player i.

Several remarks are in order to motivate the assumptions I make in specifying the set of players. An important player in a bankruptcy reorganization is the judge. There are several ways the bankruptcy court can influence the outcome of bargaining: appointment of trustee, extension or lifting of the exclusivity period, monitoring, mediating, setting deadlines, etc. Despite the powers they have, the bankruptcy judges play insignificant roles in large bankruptcy reorganizations.[8] Hence, I assume that the judge is non-strategic.

A stronger assumption I make is that I do not explicitly model the behavior of the management, and I treat its influence over the reorganization process as exogenous. There are several ways to motivate this assumption. First, a reorganization plan specifies not only how to split the securities of the firm, but also what to do with the firm. A reorganization involves changes in the corporate financial structure, for example, the rate at which earnings are reinvested, the distribution of expenditures between current and future revenue potential, the scale of investments, etc. While the creditors and the equityholders of the firm are primarily concerned with the distributional

[8]Based on interviews with bankruptcy attorneys, LoPucki and Whitford [27] state that "Judicial restraint seems to be a norm in large reorganization cases. The implicit understanding is that the appropriate judicial role involves deciding issues brought before the court by parties in interest. That each bankruptcy judge is assigned, on the average, more than 3000 new cases each year may also have something to do with such restraint."

properties of a reorganization plan, management is primarily concerned about the financial structure of the company perhaps due to self interest for future employment.[9] Second, once the firm is in bankruptcy, the agency problems between the management and the equityholders can be severe ([7], [27]). Third, when the firm becomes insolvent, the management owes a fiduciary duty to both the creditors and the equityholders. Fourth, the management turnover is significantly large during reorganization ([7], [27]). Finally, when the firm is clearly insolvent it may be impossible to devise a plan without giving the creditors a large equity stake. In this case, career concerns of the management may lead them to act in the best interest of future shareholders. In summary, it is hard to predict whether management favors larger distributions to certain creditors or equityholders. Nevertheless, management has an exclusive power to propose a reorganization plan in the first 4 months of bankruptcy which is typically extended for the duration of the bankruptcy. It is reasonable to expect that the parties with greater influence over management will be able to extract a larger distribution. I do not model the interactions between claimants and the management explicitly. Rather, I summarize the influence of each party over management with the probability of being selected as the proposer.

Preferences: Each player derives a linear utility in his share of the distribution and discounts future payoffs at a rate $\beta \in (0, 1)$.

Feasible allocations: I denote the reorganization value of the firm with R and I denote the liquidation value of the firm with γR, where R is normalized by the amount of the debt owed to c.[10]

[9]It is possible that the management may try to obtain a distribution for itself. For example, they might try to negotiate salary increases. However, as LoPucki and Whitford [27] point out, "other parties have ready access to legal process to control management excesses." To the extent that the increase in compensation is not an "excess," it is going to be reflected in the value of the firm. Hence, I assume management cannot obtain a distribution for itself.

[10]Of course, the value of the firm can change during the negotiation process. This can happen two ways. First, as the firm spends more time in bankruptcy, direct costs (such as legal fees and court costs) and indirect costs (such as lost customers) tend to increase, decreasing the firm value. Second, as time passes, new information arrives resolving uncertainty and changing the firm value. However, in a world where parties can contract on the future values of the firm, the value to be divided reflects all future values. In fact, almost all reorganization plans specify contingent payments. In another paper [12], I study

The set of feasible allocations that can be offered is given by

$$X = \{(x_s, x_c) \in I\!R^2 : x_s \geq 0, x_c \geq 0, x_s + x_c \leq R\}.$$

Institutional details: I let $a = [a_s, a_c] \in X$ denote the allocation that players are entitled to receive when the firm value is distributed according to the absolute priority rule (APR). As always, a is normalized by the amount of debt owed to c. Formally,

$$a = [\max\{R - 1, 0\}, \min\{R, 1\}] \tag{1}$$

I call the allocation a the *APR allocation.*

Before I describe the agreement rule, I define fair and equitable (henceforth, fair) proposals. A feasible proposal x is *fair for player s* if $x_c \leq 1$. It is *fair for player c* if either $x_c \geq 1$ or $x_s = 0$. Note that APR allocation is the only fair allocation for both players.

Confirmation rule: In the present context, *confirmation rule* is a better term than *agreement rule*, since a proposal can be confirmed and implemented even when some players vote against it. I assume that the confirmation rule is unanimity subject to cramdown. That is, a feasible plan x is confirmed if either both players vote for it, or x is fair for any player who votes against it.

Liquidation: I assume that whenever confirmation is not reached, there is a chance that firm is liquidated at the beginning of next period.[11] Here, by liquidation I do not necessarily mean Chapter 7. I interpret the liquidation more broadly as any event that results in the sale of the firm. I denote the probability of continuing bargaining at any period (conditional on having reached that period) by q. If bargaining breaks down, then there is liquidation and the players receive their liquidation payoff according to absolute priority rule, that is player s receives $\max\{\gamma R - 1, 0\}$ and player c receives $\min\{\gamma R, 1\}$. I denote this allocation by $v^L = [v_s^L, v_c^L]$.

---

the role of changing firm value on the timing and the terms of the agreement when some contingent contracts on the future values of the firm cannot be written.

[11] Alternatively one may assume that liquidation occurs in the current period. The main results of this paper remains unchanged with the alternative specification.

Note that if $\gamma > 1$, then from the perspective of the shareholders and creditors, liquidation could be a preferred alternative to reorganization. However, definition of feasible allocations above implicitly assumes that they cannot offer liquidation of the firm. One way to justify this assumption is to notice that whichever force that led to the choice of Chapter 11 as opposed to liquidation may remain in place during Chapter 11 process as well. Perhaps a better interpretation is that, even though the players can influence management over a certain division of the reorganization value, they have little power in asking them to give up their jobs, which is what would typically happen if the firm were to be liquidated.

Extensive form: The game is played as follows: At date 0, player i is selected as the proposer with probability π_i. The proposer chooses either to pass or to propose an allocation in X. If he proposes an allocation, player $j \neq i$ respond by either accepting or rejecting the proposal. If either j accepts the proposal or it is fair for j the game ends and the proposal is implemented. If no proposal is offered and confirmed, the process moves into date 1 with probability q. With probability $1 - q$, bargaining breaks down and players receive their liquidation allocation v^L. The bargaining process continues until either a feasible allocation is confirmed or the bargaining breaks down.

Equilibrium: An outcome of this game is a pair (η, τ) where τ is the period in which a proposal is accepted and $\eta \in X$ is the accepted allocation in period τ if confirmation occurs; and τ is the period in which liquidation occurs and η is the liquidation allocation if the liquidation occurs. For the game with the outcome (η, τ), the von-Neumann Morgenstern payoff to player i is given by $E[\beta^\tau \eta_i]$. A history is a sequence of realized proposers and actions taken up to that point. A strategy for player i is a map that specifies his intended action (whether to propose or pass, what to propose, 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.

3.1 Characterization of Subgame Perfect Equilibria

In this section I characterize the set of SP payoffs.

Proposition 1 *A payoff vector $v = [v_s, v_c]$ is SP if and only if it satisfies*

$$v_i = \begin{cases} \beta(q[\pi_i \max\{x_i^i, v_i\} + \pi_j x_i^j] + (1-q)v_i^L) & \text{if } x_j^j > v_j \\ \beta(q[\pi_i \max\{x_i^i, v_i\} + \pi_j v_i] + (1-q)v_i^L) & \text{otherwise,} \end{cases} \quad (2)$$

where $x_j^i = \min\{a_j, v_j\}$, $x_i^i = R - x_j^i$, $j \neq i$.

Whenever selected as the proposer, player i proposes the allocation x^i if $x_i^i > v_i$ and passes otherwise. Any allocation proposed is confirmed.

Proof:

I first show that the strategies described above is a subgame perfect equilibrium. Let v_i denote the continuation payoff to player i, that is v_i is the expected payoff to player i from the subgame starting next period discounted back to current period. Conditional on no breakdown, the subgame starting at any date is identical to the game starting at date 0. It follows that v_i must satisfy $v_i = \beta q E[x_i^j] + \beta(1-q)v_i^L$, where x_i^j is the payoff of i when j is the proposer, and the expectation is taken over the proposers.

Now consider an SP response to a proposal $x \in X$. Player i votes for the proposal if $x_i > v_i$ and votes against it if $x_i < v_i$. Thus, to induce acceptance by player i, a payoff maximizing proposer must offer player i a share equal to v_i. However, it might be optimal from the proposer's point of view to offer a proposal that is fair for player i instead of seeking acceptance from player i.

To make this clear, suppose $j \neq i$ is the proposer, and let $x^j = [x_s^j, x_c^j]$ denote his proposal if he offers one. In order to have his proposal confirmed, player j needs to either obtain the consent of player i or offer an allocation that is fair for player i. Such a proposal will be confirmed even if player i votes against it since it is fair for i. Note that among the feasible proposals that are fair for player i, the APR allocation maximizes player j's share. It follows that $x_i^j = \min\{v_i, a_i\}$ and $x_j^j = R - \min\{v_i, a_i\}$. Now note that player j also has the option to pass instead of offering a proposal that can be confirmed. He will do so if his continuation payoff exceeds x_j^j. That is, player j offers x^j if $x_j^j > v_j$ and passes if $x_j^j < v_j$. When $x_j^j = v_j$, player j is indifferent between passing and proposing a proposal that will be confirmed. In that case, I assume that he passes.

Note that whenever the proposer passes (instead of proposing an allocation that will be confirmed) both players receive their continuation payoff. In equilibrium, the SP strategies described above must yield to the continuation payoffs I have started with, which implies that (2) must hold. That (2) must hold for all subgame perfect equilibria follows from the fact that deviation by player i from the strategies above at a single date does not affect the continuation payoffs. Q.E.D.

I next turn to the properties of equilibria.

Proposition 2 *There exists a unique SP equilibrium. In the unique SP equilibrium, whenever selected as the proposer*

(i) both players propose an allocation that is confirmed if $\beta(q+(1-q)\gamma) < 1$*,*

(ii) player s *passes and player* c *offers an allocation that is confirmed if* $\beta(q+(1-q)\gamma) \geq 1$ *and* $R > \frac{\beta(1-q)}{(1-\beta q)}$

(iii) both players pass if $\beta(q+(1-q)\gamma) \geq 1$ *and* $R \leq \frac{\beta(1-q)}{(1-\beta q)}$.

The proof is presented in Appendix A. The intuition behind this result is the following. If $\beta(q+(1-q)\gamma) < 1$, then the expected firm value tomorrow is worth less in discounted terms than the firm value available today. In this case, both players prefer an immediate agreement to a delay in order to avoid the cost associated with the delay. If, on the other hand, $\beta(q+(1-q)\gamma) \geq 1$, then the expected firm value tomorrow is worth more in discounted terms than the firm value available today. This implies that the players can obtain a larger expected surplus by delaying confirmation. There is a risk, however, that the liquidation event will not be realized and the firm value will decrease due to discounting. When the firm value is large enough, the added risk is not enough to compensate the creditor's for the increase in the expected payoff since their payoff is a concave function of the liquidation value of the firm. But shareholder's payoff is a convex function of the liquidation value, and thus the added risk does not deter them from delaying the confirmation. Thus, when the firm value is large enough, creditors propose an allocation that will be confirmed while shareholders pass. On the other hand, when the firm value is small, the added risk associated with delay is enough to compensate the creditor's for the increase in the expected payoff, and thus both creditors and shareholders delay confirmation.

Notice that, in contrast to previous models of bargaining in bankruptcy reorganizations, the model is able to generate delays in reaching agreement in a complete information framework. This result is similar to stochastic bargaining models (see for example [28], [29]) where the surplus to be divided is changing over time to reflect the uncertainties in the underlying environment. In the model, the surplus that can be divided through bargaining is deterministic, but yet there is a random event (liquidation) that cannot be contracted upon. The driving force behind delays in both frameworks is the existence of certain states of the world that cannot be contracted upon. In that sense, our model may be viewed as a special case of stochastic bargaining games. Notice also that in this framework (as in stochastic bargaining games) delays can be efficient. In fact, in the model, equilibrium delays are always efficient since they occur only when $\beta(q + (1-q)\gamma) \geq 1$, but there may be inefficient immediate agreement when the firm value is relatively small and c is the proposer.

4 Empirical Analysis

4.1 Data

The data I use contains information on 39 large, publicly held firms that filed for Chapter 11 after October 1979 and emerged from bankruptcy before March 15, 1988, had assets of at least $100 million and had at least one issue of debt or security registered with the Securities and Exchange Commission (SEC). This data set was used by LoPucki and Whitford [25], [26], [27] and was kindly made available by Lynn LoPucki. The information available for each firm in the sample includes the number of classes, the amount of claims for each class of unsecured creditors, the distribution to unsecured creditors and shareholders, whether and equity committee is formed or not, and whether exclusivity is lifted or not. This information is obtained from the disclosure statements which must be filed with the bankruptcy courts. The distributions 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 determine the distributions to the parties involved. Of the 43 firms in the original sample, four firms were dropped because the disclosure statements were missing. For the remaining firms, I use the same valuation method LoPucki and Whitford[25] (henceforth LW) use which is described in the Appendix B.

As in LW, I focus on unsecured creditors. The main reason for this focus is the lack of required data for secured claims and priority claims. TIn the remainder of the paper, I refer to unsecured creditors simply as creditors.

LW classify a company as *insolvent* if the total value of the distributions to creditors and shareholders is less than the total claims of the creditors. Of the 39 companies in the sample, 28 were insolvent and 11 were solvent. Table 1 summarizes the claims of the creditors and the distributions creditors and shareholders normalized by the claims of the creditors for the insolvent companies. Table 2 summarizes the same information for the solvent companies. In five of the cases, it appears that creditors were paid more than the full amount of their claims. However, once the claims are adjusted to include pendency interest (i.e. the interest that accumulates during the period in Chapter 11), the overpayment disappears in all but one case.[12] In Table 3, I report the distributions to creditors and shareholders (again, normalized by the claims) once the claims are adjusted to include pendency interest. I have estimated the model using both adjusted and unadjusted data. Since the parameter estimates differ only slightly, and since the estimates indicate that the creditors would have been entitled to pendency interest in almost all of the solvent cases, I focus on the adjusted data in the remainder of the analysis.

APR is violated between unsecured creditors and equityholders in 32 of the cases. Of these 32 cases, 31 involve violations in favor of the equityholders. The payoff rate to unsecured creditors is on the average 46 cents per dollar. Weiss [35] looks at 31 companies reports a payoff rate of 53 cents on the dollar for unsecured creditors. In his study, APR is violated in 29 cases.

Franks and Torous [14] define the APR deviation for a class as the difference between the actual distribution made to that class and the distribution that class should have obtained under the APR, as a proportion of total distributions. Average APR deviation for shareholders is 0.05 in our study. Franks and Torous [14] report and average of 0.13 and Betker [7] reports an average of 0.023 as the APR deviation for shareholders. The variation in these numbers is in part due to different treatment of pendency interest. Franks and Torous [14] include pendency interest for all cases whereas Betker [7] does not include pendency interest for any case. When pendency interest is included in all cases, the payments to creditors are understated and this implies a large APR deviation in favor of shareholders. Similarly, when pendency interest is not included for solvent firm, the payment to cred-

[12]LW report that in the Storage Technology case the overpayment was entirely unintended. The confirmation of the plan was delayed nine months due to the need the satisfy conditions of the plan. In the interim, the value of the securities to be delivered to shareholders and creditors dramatically improved.

itors is overstated which understates the extent of APR deviation in favor of shareholders.

Finally, an equity committee is formed in 21 of cases and management's exclusive right to propose a reorganization plan was lifted in 6 cases.

4.2 Econometric Specification

Notation

Throughout the section, the number of firms is M and the symbol m indexes the variables and parameters relevant to the mth firm. I drop the subscript m whenever not needed. For $m = 1, \ldots, M$, let $x_m = (x_{s,m}, x_{c,m})$ where $x_{s,m}$ and $x_{c,m}$, denote the value of distributions to shareholders and creditors respectively.

The parameters of the structural model to be estimated are β, q π_s (henceforth π) and γ. It is natural to expect that the liquidation value of a firm relative to its reorganization value, γ, varies across industries. For example, in an industry where the human capital is more valuable than tangible assets, liquidation value of firms can be low compared to their reorganization values due to likely employee losses during liquidation. Variations within industries are also likely due to different capital structures, shares, locations, etc. In what follows, I assume that liquidation value relative to reorganization value relative to reorganization value is a firm specific parameter. Hence, I let γ_m denote the liquidation value of firm m relative to its reorganization value.

Parameterization

Additional assumption about the distribution of γ_m is necessary to derive the likelihood function for the model. Recall that the model is able to generate delays when $\beta(q + (1 - q)\gamma_m) \geq 1$. However, this explanation of a delay requires not only the liquidation value to be larger than reorganization value, but also the gain from liquidation to be large enough to compensate for the cost of a delay. In this analysis, I do not focus on timing of the agreement which may be explained perhaps by other elements of Chapter 11 bankruptcies such as the existence of a complicated agency structure (i.e. lawyers, committees, etc.) In what follows, I assume that, for all m, $\beta(q+(1-q)\gamma_m) < 1$ so that liquidation is never "too" desirable. Notice that this assumption is trivially satisfied when $\gamma_m \leq 1$.

Let $\bar{\gamma}$ denote the upper bound on γ_m, that is $\bar{\gamma} = \frac{1-\beta q}{\beta(1-q)}$. I assume that

γ_m are independent Beta random variables on $[0, \bar{\gamma}]$ with the density function

$$p(\gamma_m|\beta, q, a, b) = \begin{cases} \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} \gamma_m^{a-1} (\bar{\gamma} - \gamma_m)^{b-1} \bar{\gamma}^{1-a-b} & \text{if } \gamma \in (0, \bar{\gamma}) \\ 0 & \text{otherwise,} \end{cases} \tag{3}$$

where $a > 0, b > 0$. Note that Beta distribution comprises a flexible class of distributions with finite interval support and can assume a variety of shapes.

I parametrize π as

$$\pi(LIFTED, EQCOM) = \frac{\exp(\alpha_1 + \alpha_2 LIFTED + \alpha_3 EQCOM)}{\exp(\alpha_1 + \alpha_2 LIFTED + \alpha_3 EQCOM) + 1}$$

where $LIFTED$ is an dummy variable that takes the value one if management's exclusive right to propose a reorganization plan is lifted and zero otherwise, and $EQCOM$ is an dummy variable that takes the value one if an equity committee is formed and zero otherwise. It natural to expect that π depends on other variables, perhaps most importantly on management's equity holdings. Unfortunately the data on management's equity holdings is not available for most of the firm's in the data set. Similarly, other parameters of the model can be further parametrized in terms of observables that pertain to each case. Clearly including additional observables would further increase the fit of the model. Since the sample space is small, I do not introduce additional parameters.

Likelihood, Prior and Posterior

In order to reduce notation, I derive the likelihood function for a given firm. The likelihood function for the sample is equal to the product of likelihood functions for each firm. In what follows, I suppress the subscript m for firm specific quantities. Let κ denote the proposer. Conditional on the parameters, the distribution of κ is given by

$$p(\kappa|\pi) = \pi^{\delta_\kappa(s)}(1-\pi)^{\delta_\kappa(c)},$$

where $\delta_i(j) = 1$ if $i = j$, and 0 otherwise.

Let θ denote the collection of parameters that pertain to all firms, that is $\theta = (\beta, a, b, \alpha_1, \alpha_2, \alpha_3, q)$. From the perspective of parties bargaining in a given firm's reorganization, θ and γ is known.

Given θ and γ, let $v_j(\theta, \gamma)$ denote the solution to (i.e. fixed point of) (2) for $j = s, c$. Let $x = [x_s, x_c]$ denote the vector of observed payments to shareholders and creditors. By definition, $x_s + x_c = R$. Since this is an identity, it suffices to look at the distribution of x_c or x_s only. The model implies that

$$\begin{aligned} x_s &= R - \min\{v_c(\theta,\gamma), 1\} && (4) \\ x_c &= \min\{v_c(\theta,\gamma), 1\} && (5) \end{aligned}$$

if $\kappa = s$ and

$$\begin{aligned} x_s &= \min\{v_s(\theta,\gamma), \max\{R-1, 0\}\} && (6) \\ x_c &= R - \min\{v_s(\theta,\gamma), \max\{R-1, 0\}\} && (7) \end{aligned}$$

if $\kappa = c$.

Notice that although for a given value of θ, κ and γ there exists a unique value of $[x_s, x_c]$, the reverse is not true. In particular, for fixed θ and κ, it is possible to have multiple values of γ to generate the same data. This is because $v_s(\theta,\gamma)$ and $v_c(\theta,\gamma)$ are nonlinear in γ. In other words, the derivation of the likelihood function is complicated by the fact that the error term appears in the model in a nonlinear way. The likelihood function for an observation is

$$\begin{aligned} p(x_{c,m}|\theta, R_m) &= \pi \int p(x_{c,m}|\theta, \kappa = s, R_m) p(\gamma|\theta) d\gamma \\ &+ (1-\pi) \int p(x_{c,m}|\theta, \kappa = c, R_m) p(\gamma|\theta) d\gamma \qquad (8) \end{aligned}$$

Evaluating this expression involves inverting (4)-(7) to solve for γ and is presented in more detail in Appendix C. Letting boldface variables to represent collections of quantities across firms, the likelihood function for the sample is

$$p(\mathbf{x_c}|\theta, \mathbf{R}) = \prod_{m=1}^{M} p(x_{c,m}|\theta, R_m) \qquad (9)$$

The specification of the model is completed with prior density for θ denoted by $p(\theta)$. The particular density functions used in the analysis are described in complete detail in Appendix D.

By the definition of conditional probability, the posterior distribution of the parameters is

$$p(\theta|\mathbf{x_c}, \mathbf{R}) \propto p(\theta) p(\mathbf{x_c}|\theta, \mathbf{R}). \qquad (10)$$

Algorithm

Since the likelihood function and the posterior density are not available analytically, I need to take a simulation based approach. I use the importance sampling algorithm to make draws from the posterior distribution of θ. The importance sampling algorithm proceeds by generating draws from an importance sampling density whose support includes the posterior density, and then weighting the draws appropriately. In order to make the idea clear, I need additional notation. Let $j(\theta)$ denote the importance sampling density. Geweke[17] shows that the posterior mean of any function of interest, if it exists, $E[g(\theta)|\mathbf{x_c}]$ can be approximated by a weighted average

$$\frac{\sum_{i=1}^{I} g(\theta^{(i)})w(\theta^{(i)})}{\sum_{i=1}^{I} w(\theta^{(i)})}$$

where the weights are given by $w(\theta^{(i)}) = p^*(\theta^{(i)}|\mathbf{x_c})/j^*(\theta^{(i)})$. Here the asterisk is used to denote the kernel of the density. In other words, to find the weights, I only need a kernel of the posterior density, not the density itself. The product of the likelihood function and the prior is one such kernel. I use the prior density as the importance sampling density. This implies that $w(\theta) = p(\mathbf{x_c}|\theta, \mathbf{R})$, that is, the weight of each parameter draw is equal to the likelihood function at that draw.

Geweke [18] describes a method for checking against errors in density evaluation. This formal method, referred as inverse density ratio check, has power against analytical errors in the derivation of the prior density and likelihood function as well as errors in computer code. Indeed, using the test I was able to detect both kinds of errors in likelihood evaluation. It is useful to note that both the prior density evaluation and the likelihood evaluation have passed the test after the errors are fixed.

5 Results

In doing the simulations from the posterior distribution, I have discarded parameter draws that had zero likelihood, and hence zero weight. All results presented here are based on 10000 retained parameter draws. The results of the estimation for various prior specifications are reported in Tables (4)-(8).

The tables present prior and posterior means and standard deviations for the parameters. Note that the prior means and standard deviations of the parameters and functions of interest are not available analytically (except for a and b). The figures reported in the tables for the priors are obtained by simulating the prior distributions directly.

Notice that in the analysis I have not specified how long a period is since the likelihood function does not depend on the period length directly. In the model itself, a period corresponds to the amount of time it takes to propose and vote on a plan. In practice, proposing a plan can take as long as a year or could take only several days when it is an amendment of a previously proposed plan. In a data set of 309 companies, I find that the voting takes on the average 45 days, although it can be as high as almost 8 months, and as low as a week. To my knowledge, there is no study that quantifies the amount of time it would take to develop and propose, and hence, I choose prior densities for β and q rather arbitrarily.

First I check whether the data is informative. To do that I chose the prior specifications 1 and 2 in Table 4 deliberately so that the prior means "unrealistic", and the priors for all parameters are diffuse. It is interesting to note that the posterior means of are significantly different from prior means. Prior specification 1 implies[13] a mean of 0.168 for gamma, with a standard deviation of 1.095. The corresponding posterior mean is 1.066 with a standard deviation of 0.067. For prior specification 2, the implied prior mean for gamma is 2.183 with a standard deviation of 5.116 and the corresponding posterior mean is 0.958 with a standard deviation of 0.122. Finally, I choose prior specification 3 so that prior mean for γ is slightly less 0.5 which the average value reported by the management of companies in Chapter 11 as documented by Aldersen and Betker[2]. More precisely, the implied prior mean of gamma is 0.441 with a standard deviation of 1.692, while the posterior mean is 1.019 with a standard deviation of 0.133. Again, the results indicate that the data is informative and the posterior mean for γ is closer to 1 than the prior mean. Furthermore, the distribution of γ is negatively skewed under all prior specifications.

Note that the posterior mean for α_3 indicates that the formation of equity committee is not significant in describing shareholders bargaining power. Formation of an equity committee remained insignificant when I experimented

[13] Recall that the distribution of γ depends on a, b, β and q. Thus, the prior distribution of γ is a mixture of distributions since these parameters themselves are random.

with other prior specifications as well. One possible reason is that an equity committee may have two implications that work on in the opposite direction. First, agency conflicts between shareholders between management and shareholders may lead them to seek formation of a committee. Therefore, formation of an equity committee may indicate that the shareholder's are not well represented through the management. On the other hand, unlike formation of a creditor's committee which is automatic under the law, formation of an equity committee requires an active group of shareholders to convince the judge to approve the formation of equity committee. Thus, being able to form an equity committee may itself imply a relatively large bargaining power for the shareholders. These two effects work in the opposite directions and may cancel each other. Of course, the coefficient could be insignificant due to small size of the sample. Regardless of the reason, I drop α_3 in prior specifications 4 and 5.

In order to make sure that the distribution of the unobserved γ is not driven by the choice of priors, I modify the priors for β, α_1, α_2, α_3 and q so that they are similar to but more diffuse than the posteriors that correspond the previous prior specification, and I choose the prior distribution for a and b so that prior distribution of γ is a diffuse approximation of the distribution documented in Aldersen and Betker[2]. This is done in prior specification 4. The implied prior mean for γ is 0.465 with a standard deviation of 0.439. Once again, the data suggest larger values for γ with posterior a mean of 1.020 and posterior standard deviation of 0.075. Assuming that both the data set and Aldersen and Betker[2] data set are representative of the firms in Chapter 11, the results imply that management has a tendency to consistently overestimate the liquidation costs. This is consistent with the Gilson, Hotchkiss and Ruback[21] findings which suggest that valuations are used strategically in a negotiation to promote a desired bargaining outcome.

Note that the posterior distribution of the parameters β and q, and the implied distribution for unobserved γ is highly insensitive to prior specifications. This is because the liquidation value has to be positive, and therefore the likelihood can be zero for certain parameter vectors. In addition, the discount factor β and the probability of breakdown q have to lie in the unit interval. As a result, the posterior is robust to the changes in the prior since the likelihood is zero for certain parameter vectors in the support of the prior. In order to minimize the influence of priors on the posterior distribution of the remaining parameters, I iterate estimation so that at each step of the iteration: (i) the prior means are within a standard deviation of the posterior means for the previous iteration, and (ii) prior standard deviations are larger than the posterior standard deviations of the previous standard deviation. I stop this process when the prior and posterior means are within two standard deviation from each other. Prior specification 5 shows the results from the last iteration. Under this prior specification, the posterior mean of γ is 0.949 with a standard deviation of 0.169. The rest of the results refer to posteriors corresponding to this last prior specification.

I first asses the goodness of fit of the model. Figures 2 and 3 show the densities of distributions to creditors and shareholders. In Tables 5 and 6, I compare the posterior distributions with empirical densities. As can be seen from these tables, Pearson's χ^2 goodness-of-fit test does not reject the model at conventional significance levels. Posterior probability of deviation from absolute priority rule is 79.8% compared to 79.5% in the data.

I now conduct policy experiments to evaluate the impact of institutional rules on the distribution to shareholders and creditors. First, I ask what would be the effect of removing negotiations altogether and instead liquidating these firms. I find that average distributions to creditors increases to 0.48 from 0.46. Average distribution to shareholders, however, would decrease to 0.08 from 0.13. Thus, a forced liquidation eliminates the deviations from absolute priority rule but reduces the welfare by 3 cents for each $1 of creditor claims.

Second, I ask what would be the effect of removing the cramdown provisions and instead requiring the consent of all classes. Such a policy reduces the average distributions to creditors to 0.45 while increasing the average distribution to shareholders 0.14. Although the changes in average distributions is not significant, removing cramdown provisions increases the probability of deviations from absolute priority rule to 100%. These results intuitively obvious in light of the model. For an insolvent firm, cramdown provisions increase the payoff of the creditors since when they propose a plan, they propose to receive the entire surplus. This increases their continuation payoff, and hence the amount of distributions they need to be given in order to obtain their consent. Since the firm is insolvent, shareholders cannot possibly cramdown the creditors. Hence, an increase in the continuation payoff of the creditors result in an increase in the payoffs they receive when the shareholders propose as well.

Third, I evaluate the effect of lifting exclusivity for all cases. Notice that the parameter estimates imply that if the exclusivity is lifted, then creditors have slightly larger bargaining power than shareholders ($\pi = 0.43$). On the other hand, when the management has exclusive right to propose a reorganization plan, the shareholder's bargaining power is larger than the creditors bargaining power ($\pi = 0.78$). Consequently, lifting exclusivity increases the average distribution to creditors to 0.49 while decreasing the average payoff distribution to shareholders to 0.10. In this case, the probability of deviations from the absolute priority rule reduces to 48%.

To conclude, the simple bargaining model developed in this paper can explain the observed distributions to creditors and shareholders in large Chapter 11 bankruptcies. In addition, the approach allows us to conduct policy experiments to evaluate the effect of institutional features on the outcomes of the bargaining process. The approach is promising for future work on quantifying the effect of various reform proposals by taking into account equilibrium response of parties involved to the changes in the institutional structure.

A Appendix

Proof of Proposition 2:

First I prove the uniqueness of equilibrium payoffs. Suppose on the contrary that there are two equilibrium payoff vectors $v = [v_s, v_c]$ and $\bar{v} = [\bar{v}_s, \bar{v}_c]$. Let $f(v)$ be the map from $I\!R^2$ to $I\!R^2$ defined by the right hand side of (2), that is

$$f_i(v) = \begin{cases} \beta(q[\pi_i \max\{x_i^i, v_i\} + \pi_j x_i^j] + (1-q)v_i^L) & \text{if } x_j^j > v_j \\ \beta(q[\pi_i \max\{x_i^i, v_i\} + \pi_j v_i] + (1-q)v_i^L) & \text{otherwise,} \end{cases} \tag{11}$$

where $x_j^i = \min\{a_j, v_j\}$, $x_i^i = R - x_j^i$, $j \neq i$. Note that

$$||x_i^i - \bar{x}_i^i|| \leq |R - \min\{a_j, v_j\} - (R - \min\{a_j, \bar{v}_j\})| \leq |\bar{v}_j - v_j| \leq ||v - \bar{v}||$$

and

$$|\max\{x_i^i, v_i\} - \max\{\bar{x}_i^i, \bar{v}_i\}| \leq \max\{|x_i^i - \bar{x}_i^i|, |v_i - \bar{v}_i|\} \leq ||v - \bar{v}||,$$

where $||.||$ is defined by $||v - \bar{v}|| = \max\{|v_s - \bar{v}_s|, |v_c - \bar{v}_c|\}$. It follows that $|f_i(v) - f_i(\bar{v})| \leq ||v - \bar{v}||$, except possibly when $v_j > a_j > \bar{v}_j$, $v_i > a_i$ and $\bar{v}_i > a_i$. In this case, whenever selected as the proposer, player j passes if v is the equilibrium payoff vector and he proposes a_i to player i if $\bar{v}$ is the equilibrium payoff vector. It suffices to prove that there cannot be two such equilibria.

Now note that if $v_j > a_j > \bar{v}_j$, $v_i > a_i$ and $\bar{v}_i > a_i$, then whenever selected as the proposer, player i passes if v is the equilibrium payoff vector since

$$R - \min\{a_j, v_j\} = R - a_j = a_i < v_i.$$

Consequently,

$$v_j = \beta q v_j + \beta(1-q)v_j^L.$$

Also, since $\bar{v}_j < a_j$, player j gets $\bar{v}_j$ whenever i is the proposer if $\bar{v}$ is the equilibrium payoff vector regardless of player i proposes or passes. Then

$$\bar{v}_j \geq \beta q \bar{v}_j + \beta(1-q)v_j^L.$$

It follows that

$$0 < v_j - \bar{v}_j \leq \beta q(v_j - \bar{v}_j)$$

which is impossible. This contradiction completes the proof of uniqueness of payoffs.

Part(i):

If at least one player i passes, then it must be the case that $R - \min\{a_j, v_j\} \leq v_i$ which implies that

$$R \leq v_s + v_c \leq \beta(q[\pi_i(v_s + v_c) + \pi_j R] + \gamma R)$$

which is only possible when $\beta q + \beta(1-q)\gamma \geq 1$. Consequently, if $\beta q + \beta(1-q)\gamma < 1$, both players propose an allocation that will be confirmed.

Parts(ii) and (iii):

Suppose now that $\beta q + \beta(1-q)\gamma > 1$. First I show that if s proposes an allocation that is confirmed, then c also proposes an allocation that will be confirmed. To see, note that, since s proposes an allocation that will be confirmed, it must be the case that $R - \min\{v_c, a_c\} > v_s$. If $v_c \leq 1$, this is only possible if $R - v_c > v_s$. But then, $R - \min\{v_s, a_s\} \geq R - v_s > v_c$ and consequently c proposes an allocation that will be confirmed too. If $v_c > 1$ but c passes, then

$$v_c = \beta q[\pi_s v_c + (1 - \pi_s)v_c] + \beta(1-q)v_c^L.$$

Since $v_c^L \leq 1$, it follows that $v_c \leq 1$ which is a contradiction.

Next I show that s passes if $\beta q + \beta(1-q)\gamma \geq 1$. If not, by the argument above, it must be the case that both s and c propose an allocation that will confirmed. Then, it follows that

$$v_s + v_c = \beta q R + \beta(1-q)\gamma R > R.$$

Since s proposes an allocation that will be confirmed, it must be the case that $R > 1$ and $a_c < v_c$. Otherwise, $v_s \geq R - \min\{v_c, a_c\}$. Also, since c proposes an allocation that will be confirmed, it must be the case that $a_s < v_s$ (which is possible only if $\gamma R > 1$). Otherwise, $v_c \geq R - \min\{v_s, a_s\}$. But then, $v_c = \beta q + \beta(1-q) < 1$ contradicting that $v_c > 1$.

It remains to show that c proposes an allocation that will be confirmed if and only if $R > \frac{\beta(1-q)}{1-\beta q}$. Note that c always proposes an allocation that will be confirmed if $R > 1$. If not, $v_c = \beta q v_c + \beta(1-q)$ since both s and c pass and $\min\{\gamma R, 1\} = 1$ (which follows from $R > \frac{\beta(1-q)}{1-\beta q} > \frac{1}{\gamma}$). Then, $v_c = \frac{\beta(1-q)}{1-\beta q} < 1 \leq R - \min\{v_s, a_s\} = R - \min\{v_s, R-1\}$ which contradicts the assumption that c passes. Thus, it suffices to restrict the attention to the case where $R < 1$ in which case $a_c = R$ and $a_s = 0$. If c proposes, his payoff is given by

$$v_c = \frac{\beta q \pi_c R + \beta(1-q)\min\{\gamma R, 1\}}{1 - \beta q \pi_s}.$$

Since he proposes an allocation that is confirmed whenever $v_c < R$, it must be the case that $R > \frac{\beta(1-q)}{1-\beta q}$. If c passes, his payoff is given by

$$v_c = \frac{\beta(1-q)\min\{\gamma R, 1\}}{1 - \beta q}.$$

Since he passes whenever $v_c \geq R$, it must be the case that $R \leq \frac{\beta(1-q)}{1-\beta q}$.

Q.E.D.

B Appendix

In this section, I briefly summarize of valuation methods used by LoPucki and Whitford [25]. The objective is to determine the value of the securities distributed to the creditors and shareholders as of the day after confirmation. The values are obtained by discounting the price back to the date of confirmation. For public securities which are actually traded, the price is the earliest observed closing price. For public securities that are not traded, the price is the average of bid and ask quotations. For securities that are privately traded, the price is the average price of all trades which occurred during some period not exceeding one month.

The payments are discounted at a rate r, which is determined by the formula

$$r = r_s + \frac{n}{7}(r_s - r_b)$$

where n is the number of full years between the confirmation and payment, r_s is the average of prime rate and 3 month treasury bill rate and r_b is the Moody's Baa rate for corporate bonds.

C Appendix

In this section I derive the likelihood function (8). I first solve for $v_j(\theta, \gamma)$ (i.e. 2) and then invert (4)-(7) to solve for γ. In order to reduce notation, I will omit the firm subscripts and the conditioning variables. In the remainder of the section, I consider a number of cases depending on various restrictions on the values of the variables and parameters in the model. For a generic case C, let $\delta(C)$ denote the indicator function which takes the value 1 if the restrictions imposed by C are satisfied and 0 otherwise.

Notice that it is impossible to have $v_c > 1, v_s > R-1$ since $v_s + v_c = (\beta q + \beta(1-q)\gamma)R < R$ where the equality follows from 2 and the inequality is by the assumption bounding γ.

Consider first the case where $R < 1$. If $\kappa = c$ is the proposer, then the model implies that $x = [x_s, x_s] = [0, R]$. Hence,

$$p(x_c|\kappa = c, R < 1) = \delta(x = [0, R]) \tag{12}$$

If $\kappa = s$, then $[x_s, x_c] = [R - v_c, v_s]$ and

$$\begin{aligned} p(x_c|\kappa = s, R < 1) &= p(x_c|\kappa = s, R < 1, \gamma R < 1) Pr(\gamma < \frac{1}{R}) \\ &+ p(x_c|\kappa = s, R < 1, \gamma R > 1) Pr(\gamma > \frac{1}{R}) \end{aligned} \tag{13}$$

Now, if $\gamma R < 1$, then

$$v_c = \frac{(\beta q\ (1-\pi) + \beta\,\gamma\ (1-q))\ R}{1 - \beta q \pi}$$

and $x_c = v_c$ implies that

$$\gamma = \frac{x_c(1 - \beta q \pi) - \beta q(1-\pi)R}{\beta R(1-q)}.$$

Hence,

$$\begin{aligned} p(x_c|\kappa = s, R < 1, \gamma R < 1) Pr(\gamma < \frac{1}{R}) \\ = p(\gamma)\frac{1 - \beta q \pi}{\beta R(1-q)}\delta(\gamma < \frac{1}{R}). \end{aligned} \tag{14}$$

If $\gamma R > 1$, then,

$$v_c = \frac{\beta\ (1-q) + \beta q\ (1-\pi)\ R}{1 - \beta q \pi}$$

and $x_c = v_c$ implies that

$$p(x_c|\kappa = s, R < 1, \gamma R > 1) Pr(\gamma > \frac{1}{R}) = \delta(x_c = v_c) Pr(\gamma > \frac{1}{R}). \qquad (15)$$

Using (14) and (15), I obtain (13).

Next consider the case where $R \geq 1$. Recall that it is impossible to have $v_c > 1$ and $v_s > R - 1$. Then $p(x_c|\kappa = j, R > 1)$ can be expressed as

$$p(x_c|\kappa = j, R > 1) = \sum_{i=1}^{6} p(x_c|\kappa = j, R > 1, C_i) p(C_i) \qquad (16)$$

where

$$\begin{aligned} C_1 &= (\gamma R < 1, v_c < 1, v_s > R - 1) \\ C_2 &= (\gamma R < 1, v_c < 1, v_s < R - 1) \\ C_3 &= (\gamma R < 1, v_c > 1, v_s < R - 1) \\ C_4 &= (\gamma R > 1, v_c < 1, v_s > R - 1) \\ C_5 &= (\gamma R > 1, v_c < 1, v_s < R - 1) \\ C_6 &= (\gamma R > 1, v_c > 1, v_s < R - 1) \end{aligned}$$

I will now look at each case separately.

$\mathbf{C_1} = (\gamma R < 1, v_c < 1, v_s > R - 1)$:
In this case

$$\begin{aligned} v_c &= \frac{\beta q\ (1-\pi) + \beta\,\gamma\ (1-q)\ R}{1-\beta q\pi} \\ v_s &= \frac{\beta q\ (1-p-R(1-\beta q\pi)) - \beta\,\beta q\pi\,\gamma\ (1-q)\ R}{1-\beta q\pi} \end{aligned}$$

Note that $\gamma R < 1$, $v_c < 1$ and $v_s > R - 1$ if and only if,

$$\gamma < \gamma_H = \min\{\frac{1-\beta q}{\beta q}, \frac{1}{R}\}$$

and

$$\gamma > \gamma_L = \frac{(1-\beta q)(1-R(1-\beta q\pi))}{\beta(1-q)\beta q\pi R}.$$

If $\kappa = s$, then $[x_s, x_c] = [R - v_c, v_c]$ implies

$$\gamma = \frac{x_c(1-\beta q\pi) - \beta q(1-\pi)}{\beta\, R(1-q)}$$

Then

$$p(x_c|\kappa = s, R > 1, C_1) = p(\gamma)\frac{1-\beta q\pi}{\beta R(1-q)} \tag{17}$$

and

$$p(C_1) = \delta(\gamma_L < \gamma < \gamma_H) \tag{18}$$

If $\kappa = c$, then $[x_s, x_c] = [R-1, 1]$ and hence

$$p(x_c|\kappa = c, R > 1, C_1) = \delta(x_c = 1) \tag{19}$$

and

$$p(C_1) = Pr(\gamma_L < \gamma < \gamma_H) \tag{20}$$

$\mathbf{C_2} = (\gamma R < 1, v_c < 1, v_s < R - 1)$:
In this case

$$\begin{aligned} v_c &= \frac{\beta(1-q)\gamma(1-\beta q(1-\pi)) + \beta q(1-\pi)(1-\beta q)}{1-\beta q} \\ v_s &= \frac{\beta q\pi(1-\beta q) - \beta q\pi\beta(1-q)\gamma}{1-\beta q} R \end{aligned}$$

If $\kappa = s$, then $[x_s, x_c] = [R - v_c, v_c]$ implies

$$\gamma = \frac{(1-\beta q)(x_c + R\beta q(1-\pi))}{\beta(1-q)(1-\beta q(1-\pi))R}.$$

Then

$$p(x_c|\kappa = s, R > 1, C_2) = p(\gamma)\frac{1-\beta q}{\beta(1-q)(1-\beta q(1-\pi))R}. \tag{21}$$

Note that $v_c = (\beta q + \beta(1-q)\gamma)R - v_s$, and $v_s = x_s$. Thus $v_s < R - 1$ and $v_c < 1$ if and only if

$$\gamma < \gamma_H = \frac{R(1-\beta q) - 1 + x_c}{\beta(1-q)R}.$$

Therefore,

$$p(C_2) = \delta(x_c < 1, \gamma < \min\{\frac{1}{R}, \gamma_H\}) \quad (22)$$

If $\kappa = c$, then $[x_s, x_c] = [v_s, R - v_s]$ implies

$$\gamma = \frac{(1-\beta q)(\beta q \pi R - x_s)}{\beta q \pi R \beta (1-q)}$$

Then

$$p(x_c|\kappa = c, R > 1, C_2) = p(\gamma)\frac{1-\beta q}{\beta q \pi R \beta (1-q)} \quad (23)$$

Note that $v_c = (\beta q + \beta(1-q)\gamma)R - v_s$, and $v_s = x_s$. Thus $v_s < R - 1$ and $v_c < 1$ if and only if

$$\gamma < \gamma_H = \frac{1 + x_s - \beta q R}{\beta(1-q)R}.$$

Therefore,

$$p(C_2) = \delta(x_c < 1, \gamma < \min\{\frac{1}{R}, \gamma_H\}) \quad (24)$$

$\mathbf{C_3} = (\gamma R < 1, v_c > 1, v_s < R - 1)$:
In this case

$$\begin{aligned} v_c &= (\beta q + \beta(1-q)\gamma)R - \frac{\beta q \pi \ (R-1)}{1 - \beta q(1-\pi)} \\ v_s &= \frac{\beta q \pi \ (R-1)}{1 - \beta q(1-\pi)} \end{aligned}$$

If $\kappa = s$, then $[x_s, x_c] = [R-1, 1]$ and hence

$$p(x_c|\kappa = s, R > 1, C_3) = \delta(x_c = 1) \quad (25)$$

If $\kappa = c$ is the proposer, then $[x_s, x_c] = [v_s, R - v_s]$ and hence

$$p(x_c|\kappa = s, R > 1, C_3) = \delta(x_s = \frac{\beta q \pi \ (R-1)}{1 - \beta q(1-\pi)}). \quad (26)$$

Note that $v_s < R - 1$ is always satisfied since $\beta < 1$. Also, $\gamma R < 1$ and $v_c < 1$ if and only if,

$$\gamma < \gamma_H = \frac{1}{R},$$

$$\gamma > \gamma_L = \frac{(1-\beta q)}{(1-\beta q(1-\pi))\beta(1-q)R}.$$

Therefore,

$$p(C_3) = Pr(\gamma_L < \gamma < \gamma_H). \tag{27}$$

$\mathbf{C_4} = (\gamma R > 1, v_c < 1, v_s > R-1)$:
In this case

$$\begin{aligned} v_c &= \frac{\beta(1-q\pi)}{1-\beta q\pi} \\ v_s &= (\beta q + \beta(1-q)\gamma)R - \frac{\beta(1-q\pi)}{1-\beta q\pi} \end{aligned}$$

If $\kappa = s$, then $[x_s, x_c] = [R - v_c, v_c]$ and hence

$$p(x_c|\kappa = s, R > 1, C_4) = \delta(x_c = \frac{\beta(1-q\pi)}{1-\beta q\pi}) \tag{28}$$

If $\kappa = c$ is the proposer, then $[x_s, x_c] = [R-1, 1]$ and hence

$$p(x_c|\kappa = s, R > 1, C_4) = \delta(x_c = 1). \tag{29}$$

Note that $v_c < 1$ is always satisfied since $\beta < 1$. Also, $\gamma R > 1$ and $v_s > R - 1$ if and only if,

$$\gamma > \gamma_L = \max\{\frac{1}{R}, \frac{\beta + R(1-\beta q)(1-\beta q\pi) - 1}{\beta(1-\beta q\pi)(1-q)\,R}\}.$$

Therefore,

$$p(C_4) = Pr(\gamma > \gamma_L). \tag{30}$$

$\mathbf{C_5} = (\gamma R > 1, v_c < 1, v_s < R-1)$:
In this case

$$\begin{aligned} v_c &= \frac{\beta(1-q)(1-\beta q\gamma(1-\pi)R) - \beta q(1-\pi)(1-\beta q)\,R}{1-\beta q} \\ v_s &= \frac{\beta q\pi(1-\beta q)\,R - \beta\,(1-q)\,(1-(1-\beta q\pi)\gamma R)}{1-\beta q} \end{aligned}$$

If $\kappa = s$, then $[x_s, x_c] = [R - v_c, v_c]$ implies

$$\gamma = \frac{\beta(1-q) + (\beta q(1-\pi)R - x_c)(1-\beta q)}{\beta q(1-\pi)\beta(1-q)R}$$

$$p(x_c|\kappa = s, R > 1, C_2) = p(\gamma)\frac{1-\beta q}{\beta q(1-\pi)\beta(1-q)R}. \tag{31}$$

Since

$$v_s = (\beta q + \beta(1-q)\gamma)R - v_c = (\beta q + \beta(1-q)\gamma)R - x_c,$$

$v_c < 1$ if and only if $x_c < 1$ and $v_s < R - 1$ if and only if

$$\gamma < \gamma_H = \frac{R(1-\beta q) - 1 + x_c}{\beta(1-q)R}.$$

Therefore,

$$p(C_5) = \delta(x_c < 1, \frac{1}{R} < \gamma < \gamma_H) \tag{32}$$

If $\kappa = c$, then $[x_s, x_c] = [v_s, R - v_s]$ implies

$$\gamma = \frac{\beta(1-q) + (1-\beta q)(x_s - \beta q\pi R)}{\beta(1-\beta q\pi)(1-q)R}$$

Then

$$p(x_c|\kappa = c, R > 1, C_2) = p(\gamma)\frac{1-\beta q}{\beta q(1-\pi)\beta(1-q)R}. \tag{33}$$

Since

$$v_c = (\beta q + \beta(1-q)\gamma)R - v_s = (\beta q + \beta(1-q)\gamma)R - x_s,$$

$v_s < R - 1$ if and only if $x_s < R - 1$ and $v_c < 1$ if and only if

$$\gamma < \gamma_H = \frac{1 + x_s - \beta q R}{\beta(1-q)R}.$$

Therefore,

$$p(C_5) = \delta(x_c < 1, \frac{1}{R} < \gamma < \gamma_H) \tag{34}$$

$\mathbf{C_6} = (\gamma R > 1, v_c > 1, v_s < R - 1)$:
In this case

$$\begin{aligned} v_c &= \frac{\beta q(1-\beta q(1-\pi))R - \beta q\pi(R-1) + \beta(1-q)(1-\beta q\gamma(1-\pi)R)}{1-\beta q(1-\pi)} \\ v_s &= \frac{\beta(1-q)(\gamma R - 1) - \beta q\pi(R-1)}{1-\beta q(1-\pi)} \end{aligned}$$

Note that $\gamma R > 1$, $v_c > 1$ and $v_s < R - 1$ if and only if,

$$\gamma < \frac{\beta q R(1-\pi)(1-\beta q) - 1 + \beta}{\beta q(1-\pi)\beta(1-q)R}$$

and

$$\gamma < \frac{\beta(1-q) + (1-\beta q)(R-1)}{\beta(1-q)R}.$$

Let γ_H denote the minimum of the right hand sides of the above two inequalities.

If $\kappa = s$, then $[x_s, x_c] = [R-1, 1]$, and hence

$$p(x_c|\kappa = s, R > 1, C_6) = \delta(x_c = 1) \tag{35}$$

and

$$p(C_6) = Pr(\frac{1}{R} < \gamma < \gamma_H) \tag{36}$$

If $\kappa = c$, then $[x_s, x_c] = [R - v_s, v_s]$ implies that

$$\gamma = \frac{\beta(1-q) - \beta q\pi(R-1) + x_s(1-\beta q(1-\pi))}{\beta R(1-q)}$$

and hence

$$p(x_c|\kappa = c, R > 1, C_5) = p(\gamma)\frac{\beta(1-q)R}{1-\beta q(1-\pi)} \tag{37}$$

and

$$p(C_6) = \delta(\frac{1}{R} < \gamma < \gamma_H) \tag{38}$$

D Appendix

I use independent priors for individual components of $\theta = (\beta, q, \pi, a, b)$, that is $p(\theta) = p(\beta)p(q)p(\pi)p(a)p(b)$. For the parameters that lie in the unit interval (i.e. β, q and π), the priors are specified by a normal prior on the corresponding logit transformation, that is,

$$\log(\frac{\beta}{1-\beta}) \sim \quad \mathrm{N}(\mu_\beta, \sigma_\beta^2),$$

$$\log(\frac{q}{1-q}) \sim \quad \mathrm{N}(\mu_q, \sigma_q^2),$$

and

$$\log(\frac{\pi}{1-\pi}) \sim \quad \mathrm{N}(\mu_\pi, \sigma_\pi^2).$$

For parameters a and b I specify log-normal priors:

$$\log(a) \sim \quad \mathrm{N}(\mu_a, \sigma_a^2),$$

and

$$\log(b) \sim \quad \mathrm{N}(\mu_b, \sigma_b^2),$$

Finally, for parameters α_1, α_2 and α_3, I use normal priors.

References

[1] Aghion, Philippe, Hart, Oliver, and Moore, John. "The Economics of the Bankruptcy Reform," *Journal of Law, Economics, and Organization* 8:523-546, 1992.

[2] Alderson, Michael J., and Betker, Brian L. "Liquidation Costs and Capital Structure." *Journal of Financial Economics* 39:45-69, 1995.

[3] Baird, Douglas G. "The Uneasy Case for Corporate Reorganizations." *Journal of Legal Studies* 15:127-147, 1986.

[4] Baird, Douglas G., and Picker, Randal C. "A Simple Noncooperative Bargaining Model of Corporate Reorganizations." *Journal of Legal Studies* XX: June 1991.

[5] Bebchuck, Lucian A. "A New Approach to Corporate Reorganizations." *Harvard Law Review* 101:775-804, 1988.

[6] Bebchuck, Lucian A., and Chang, Howard F. "Bargaining and the Division of Value in Corporate Reorganization." *Journal of Law, Economics, and Organization* 8:253-279, 1992.

[7] Betker, Brian L. "Management's Incentives, Equity's Bargaining Power, and Deviations from Absolute Priority in Chapter 11 Bankruptcies." *Journal of Business* 68:161-183, 1995.

[8] Bradley, Michael and Rosenzweig, Michael. "The Untenable Case for Chapter 11." *Yale Law Journal* 101:1043, 1992.

[9] Diermeier, Daniel, Hülya K. K. Eraslan, and Merlo, Antonio. "A Structural Model of Government Formation." forthcoming, *Econometrica.*

[10] Eberhart, Allan; Moore, William, and Roenfeldt, Rodney. "Security Pricing and Deviations from the Absolute Priority Rule in Bankruptcy Proceedings." *Journal of Finance* 45:1457-69, 1990.

[11] Eisenberg, Theodore and LoPucki, Lynn. "Shopping For Judges: An Empirical Analysis Of Venue Choice in Large Chapter 11 Reorganizations." *Cornell Law Review* 84:967, May 1999.

[12] Eraslan, Hülya K. K. "A Stochastic Bargaining Model of Corporate Bankruptcy Reorganization." 2000.

[13] Eraslan, Hülya K. K., and Merlo, Antonio. "Majority Rule in a Stochastic Model of Bargaining." *Journal of Economic Theory*, 103: 31-48, 2002.

[14] Franks, Julian R., and Torous, Walter N. "An Empirical Investigation of U.S. Firms in Reorganization." *The Journal of Finance* XLIV:747-769, July 1989.

[15] Franks, Julian R., and Torous, Walter N. "A Comparison of Financial Recontracting in Distressed Exchanges and Chapter 11 Reorganizations." *Journal of Financial Economics* 35:349-370, 1994.

[16] Geweke, John. "Using Simulation Methods for Bayesian Econometric Models: Inference, Development and Communication." *Econometric Reviews* 18:1-126, 1999.

[17] Geweke, John. "Bayesian Inference in Econometric Models Using Monte Carlo Integration." *Econometrica* 57:1317-1339, 1989.

[18] Geweke, John. "Getting it Right: Checking for Errors in Bayesian Models and Posterior Simulators."University of Iowa, 2001.

[19] Geweke, John, and Keane, M. "An Empirical Analysis of Income Dynamics Among Men in the PSID: 1968-1989" *Journal of Econometrics* forthcoming, 2000.

[20] Gilson, Stuart C., Kose, John, and Lang, Larry H. P. "Troubled Debt Restructurings: An Empirical Study of Private Reorganization of Firms in Default" *Journal of Financial Economics* 27:315-53, 1990.

[21] Gilson, Stuart C., Hotchkiss, Edith S., and Ruback, Richard S. "Valuation of Bankrupt Firms." *Review of Finacial Studies* 13: 43-74, 2000.

[22] Jackson, T. The Logic and Limits of Bankruptcy Law. Mass.: Harvard University Press, 1986.

[23] Jackson, Thomas H., and Scott, Robert E. "On the Nature of Bankruptcy: An Essay on Bankruptcy Sharing and Creditors' Bargain." *Virginia Law Review* 75:155-204, March 1989.

[24] Kordana, Kevin A., and Posner, Eric A. "A Positive Theory of Chapter 11," *New York University Law Review* 74:161, April 1999.

[25] LoPucki, Lynn M., and Whitford, William C. "Bargaining Over Equity's Share in the Bankruptcy Reorganization of Large, Publicly Held Companies." *University of Pennsylvania Law Review* 139:125-196, 1990.

[26] LoPucki, Lynn M., and Whitford, William C. "Venue Choice and Forum Shopping in the Bankruptcy Reorganization of Large, Publicly Held Companies." *Wisconsin Law Review* 11, January 1991.

[27] LoPucki, Lynn M., and Whitford, William C. "Corporate Governance in the Bankruptcy Reorganization of Large Publicly Held Companies.", *University of Pennsylvania Law Review* 141:669-800, January 1993.

[28] Merlo, Antonio, and Wilson, Charles A. "A Stochastic Model of Sequential Bargaining with Complete Information." *Econometrica* 63:371-99, March 1995.

[29] Merlo, Antonio, and Wilson, Charles A. "Efficient Delays in a Stochastic Model of Bargaining." *Economic Theory* 11:39-55, January 1998.

[30] Merton, R. C. "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." *Journal of Finance* 29:449-469, 1974.

[31] Osborne, Martin J. and Rubinstein, Ariel. Bargaining and Markets. Academic Press. 1990.

[32] Roe, Mark J. "Bankruptcy and Debt: A New Model for Corporate Reorganization." *Columbia Law Review* 83:527-602, 1983.

[33] Sieg, Holger. "Estimating a Bargaining Model with Asymmetric Information: Evidence from Medical Malpractice Disputes." *Journal of Political Economy*, 108: 1006-1021, 2000.

[34] Strömberg, Per. "Conflicts of Interest and Market Illiquidity in Bankruptcy Auctions: Theory and Test." *Journal of Finance*, 55: 2641-2691, 2000.

[35] Weiss, Larry. "Bankruptcy Resolution: Direct Costs and Violation of Priority of Claims." *Journal of Financial Economics* 27:285-314, 1990.

[36] White, Michelle J. "Survey Evidence on Business Bankruptcy." Handbook of Modern Finance, Logue, Dennis E., ed., Warren, Gorham and Lamont, 1994.

Table 1: Distribution to Creditors and Shareholders for Insolvent Companies

Company	Claims (in million dollars)	Distributions to creditors normalized by claims	Distributions to shareholders normalized by claims
Air Florida	198.2	0.0305	0
Amarex	212.5	0.0783	0
Anglo Energy	140.4	0.6464	0.0336
Baldwin-United	440	0.5434	0.0454
Braniff	691	0.0486	0.0025
Combustion Equipment	133.5	0.2774	0.0027
Cook United	66.8	0.3869	0.034
Crystal Oil	204.2	0.2389	0.0192
Dreco	40.6	0.1171	0.1595
Energetics	39.7	0.2904	0.0764
Evans Products	9.2	0.2649	0
FSC	112.7	0.3394	0.0171
HRT	115.6	0.6852	0.0494
Itel	977.1	0.6495	0.0187
KDT	63	0.626	0.0502
Marion	148.7	0.4035	0.0062
McLouth	141.4	0.1823	0.0098
MGF	182.5	0.011	0
NuCorp	292.4	0.1339	0
Oxoco	113.4	0.0948	0.0039
Pizza Time Theatre	112.6	0.1998	0.0044
Saxon	320.3	0.4124	0.0255
Seatrain Lines	300	0.0048	0
Tacoma Boatbuilding	129.1	0.2961	0.0193
Towle	52.4	0.356	0.0211
Towner	126.5	0.0251	0
White Motor	285.5	0.6086	0.0164
Wickes	1270.9	0.8163	0.0496

Table 2: Distribution to Creditors and Shareholders for Solvent Companies

Company	Claims (in million dollars)	Distributions to creditors normalized by claims	Distributions to shareholders normalized by claims
AM International	269.2	0.8611	0.1429
Charter	425	0.8631	0.2145
Continental	245.4	1.1431	1.7997
Manville	472.5	1.2534	0.2812
Lionel	143.4	0.8556	0.2691
Penn-Dixie	19.8	0.9679	0.378
Revere	151.9	0.9268	0.5513
Salant	62	0.9651	0.6052
Smith International	275	1.0711	0.5807
Storage Technology	773.6	1.3053	0.1516
Wilson Foods	67.7	0.8737	0.8805

Table 3:Distribution to Creditors and Shareholders for Solvent Companies Adjusted for the Pendency Interest

Company	Interest rate	Years in bankruptcy	Claims (in million dollars)	Distributions to creditors normalized by claims	Distributions to shareholders normalized by claims
AM International	12.50%	2.4	357.1	0.6491	0.1077
Charter	7.40%	2.7	515.3	0.7118	0.1769
Continental	8.20%	2.8	306	0.9167	1.4433
Manville	8.50%	4.3	671	0.8826	0.198
Lionel	10.10%	3.6	202.8	0.6051	0.1903
Penn-Dixie	15.30%	1.9	25.9	0.7385	0.2884
Revere	9.40%	2.8	195.3	0.7206	0.4287
Salant	7.90%	2.2	73.3	0.8164	0.512
Smith International	8.10%	1.7	313.9	0.9383	0.5087
Storage Technology	8.00%	2.6	944.9	1.0686	0.1241
Wilson Foods	10.10%	0.9	73.8	0.8012	0.8075

Table 4: Parameter Estimates

Parameter	Prior Specification 1				Prior Specification 2				Prior Specification 3			
	Prior		Posterior		Prior		Posterior		Prior		Posterior	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
β	0.696	0.186	0.953	0.012	0.697	0.182	0.944	0.011	0.699	0.182	0.938	0.006
a	0.020	0.114	0.779	0.300	6.865	34.788	4.630	1.706	0.160	0.467	2.403	0.368
b	0.665	0.810	0.366	0.160	1.557	1.823	0.932	0.137	1.494	1.248	0.785	0.088
α_1	-0.001	1.014	0.683	0.423	-0.017	1.003	0.750	0.370	-0.008	0.998	1.386	0.422
α_2	-0.013	1.006	0.140	0.911	-0.006	0.988	-0.581	0.604	-0.018	0.997	-1.577	0.546
α_3	-0.014	1.014	0.438	0.478	0.023	0.992	0.536	0.587	-0.006	1.009	0.121	0.494
q	0.699	0.181	0.449	0.097	0.697	0.184	0.507	0.126	0.696	0.183	0.287	0.079

Parameter	Prior Specification 4				Prior Specification 5			
	Prior		Posterior		Prior		Posterior	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
β	0.931	0.068	0.947	0.004	0.931	0.069	0.942	0.006
a	1.008	1.015	4.948	0.613	2.506	1.013	3.842	0.877
b	1.542	1.172	0.953	0.151	0.910	0.648	0.833	0.173
α_1	1.377	0.418	1.245	0.107	1.243	0.107	1.256	0.097
α_2	-1.581	0.542	-1.565	0.362	-1.561	0.362	-1.528	0.293
q	0.497	0.209	0.497	0.042	0.500	0.210	0.443	0.074

Table 5: Density functions of Normalized Distributions to Creditors and Goodness-of-fit Test

Interval	Data	Model
0.20	0.282	0.259
0.40	0.205	0.249
0.60	0.077	0.117
0.80	0.256	0.167
1.00	0.154	0.186
More	0.026	0.022
Mean	0.455	0.461
χ^2 test		2.9446
Pr(χ^2 (6) $\geq$ 3.984)		0.7085

Table 6: Density functions of Normalized Distributions to Shareholders and Goodness-of-fit Test

Interval	Data	Model
0.04	0.564	0.576
0.08	0.128	0.105
0.12	0.051	0.063
0.16	0.051	0.045
0.20	0.077	0.041
More	0.128	0.169
Mean	0.139	0.134
χ^2 test		1.8774
Pr(χ^2 (6) $\geq$ 3.984)		0.8658

Figure 1: Normalized Distributions to Creditors

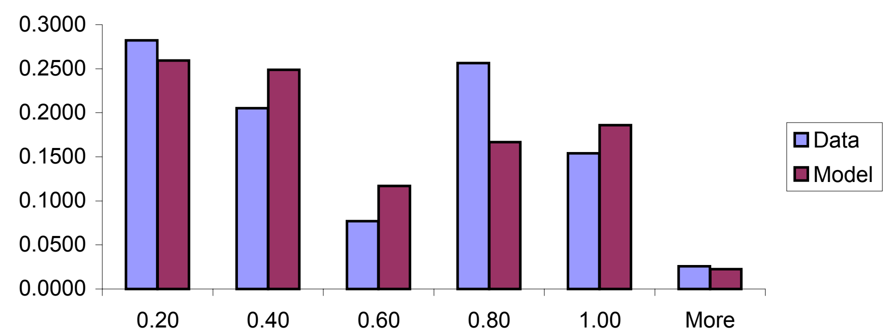
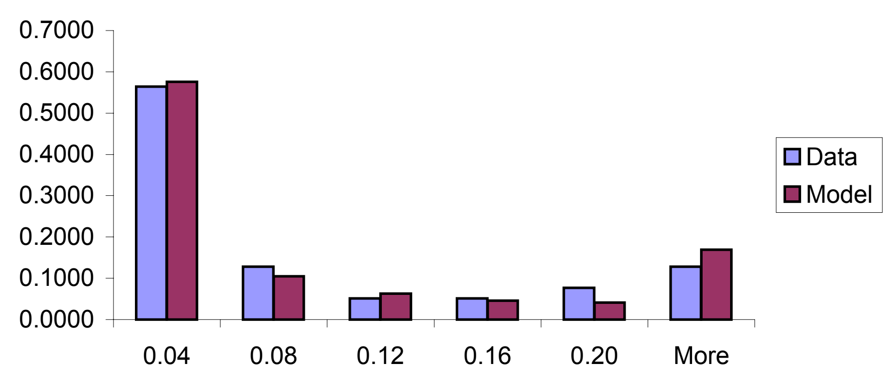


Figure 2: Normalized Distributions to Shareholders



The Rodney L. White Center for Financial Research

The Wharton School
University of Pennsylvania
3254 Steinberg Hall-Dietrich Hall
3620 Locust Walk
Philadelphia, PA 19104-6367

(215) 898-7616
(215) 573-8084 Fax
http://finance.wharton.upenn.edu/~rlwctr

The Rodney L. White Center for Financial Research is one of the oldest financial research centers in the country. It was founded in 1969 through a grant from Oppenheimer & Company in honor of its late partner, Rodney L. White. The Center receives support from its endowment and from annual contributions from its Members.

The Center sponsors a wide range of financial research. It publishes a working paper series and a reprint series. It holds an annual seminar, which for the last several years has focused on household financial decision making.

The Members of the Center gain the opportunity to participate in innovative research to break new ground in the field of finance. Through their membership, they also gain access to the Wharton School's faculty and enjoy other special benefits.

Members of the Center

2002 – 2003

Directing Members

Geewax, Terker & Company
Morgan Stanley
The Nasdaq Stock Market, Inc.
The New York Stock Exchange, Inc.

Members

Aronson + Partners
Bear, Stearns & Co., Inc.
Delaware Investment Advisors
Goldman, Sachs & Co.
Twin Capital

Founding Members

Ford Motor Company Fund
Merrill Lynch, Pierce, Fenner & Smith, Inc.
Oppenheimer & Company
Philadelphia National Bank
Salomon Brothers
Weiss, Peck and Greer