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Could chapter 11 redeem itself? Wealth and welfare effects of the redemption option

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Abstract: In its reform of the US bankruptcy procedure, the American Bankruptcy Institute (ABI) is proposing to grant a redemption option to junior creditors and let them exit the bargaining process. A game-theoretic, continuous-time model of the leveraged firm is developed to assess the wealth transfers and welfare impacts of such an amendment. After fitting the model to the current outcomes of Chapter 11, numerical experiments show that the compensation to junior creditors is too high and that the redemption option replaces one type of Absolute Priority Rule violations with another. Experiments also show that, while the ABI reform reduces bankruptcy costs, it also increases the frequency of liquidation. We conclude that it may be advisable to revise the design of the redemption and to offer it on a case-by-case basis.

Keywords: Chapter 11, bankruptcy, APR violation, recovery, game theory, dynamic programming

Résumé : Dans le cadre de sa réforme du processus d'insolvabilité aux États-Unis, l'American Bankruptcy Institute (ABI) propose l'octroi d'une option de remboursement aux créanciers juniors, leur permettant de se retirer du processus de négociation. Nous utilisons un modèle de jeu dynamique du processus de négociation d'une éventuelle réorganisation de la dette dans le cadre de la procédure légale aux États-Unis (Chapitre 11 de la loi sur les faillites). Le modèle est tout d'abord calibré à partir des conclusions actuelles de la procédure de faillite et est ensuite utilisé afin d'évaluer l'impact de l'amendement proposé. Nos expériences numériques montrent que la compensation offerte aux créanciers juniors est trop élevée et que l'effet de l'option de remboursement est de remplacer un type de violation de la règle de priorité des créances (Absolute Priority Rule) par un autre. Elles montrent également que, bien que la réforme proposée réduise les coûts de faillite, elle augmente également la fréquence des liquidations. Nous concluons qu'il serait sans doute opportun de réviser la conception de l'option de remboursement et de l'offrir au cas par cas.

Mots clés : Chapitre 11, insolvabilité, priorité des créances, recouvrement, théorie des jeux, programmation dynamique

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1 Introduction

In modern economies, the legal bankruptcy procedure plays an instrumental role in resolving corporate financial distress. For firms opting to restructure under the protection of the bankruptcy law, the procedure defines a set of rules under which claimholders can negotiate. It also stands as an enforceable alternative for distressed firms trying to reach an out-of-court agreement with their claimholders through a private workout. As emphasized by Aghion, Hart & Moore (1992), the bankruptcy procedure is designed to facilitate the bargaining process among claimants to avoid costly liquidation, while at the same time respecting initial contractual agreements as much as possible. In that spirit, empirical studies on the US bankruptcy procedure (reorganization under Chapter 11, or liquidation under Chapter 7) have assessed its performance along the following dimensions: its duration, its liquidation rate, the creditors' recovery, and the deviations from the Absolute Priority Rule (APR) it entails.[1]

This paper examines the impact, along those same dimensions, of an amendment to the US bankruptcy procedure. This amendment, which was recently proposed by the American Bankruptcy Institute (ABI), introduces a *redemption option*.[2] The ABI justifies the reform by pointing out that financially distressed corporations have been relying less and less on Chapter 11, often preferring faster and less-costly out-of-court restructuring. Under the proposed change, a junior creditor is entitled to a share of the ongoing company, called the redemption option value, even if a senior creditor is not paid in full. This is an important departure from the APR. More specifically, the junior creditor's share is "the value of a hypothetical option to purchase the entire firm with an exercise price equal to the redemption price [...] and a duration equal to the redemption period" (American Bankruptcy Institute 2014, p. 209). More precisely, the junior creditor would be offered the value of a hypothetical option on the firm's assets, with a three-year maturity starting from the plan petition date. The goal of the proposed reform is to accelerate the resolution of financial distress, thereby reducing the costs of Chapter 11, by providing junior creditors with an exit strategy.

Following the publication of the ABI report, a burgeoning literature has emerged, examining the ramifications of the ABI's proposals. Recent papers summarize these proposals and explain how changes could potentially reduce the length of the reorganization process (see, e.g., PIMCO 2015 and Wessel & de Weijs 2015). Aside from its benefits, the ABI reform could potentially disadvantage senior creditors by limiting their rights to be paid in full before junior creditors, and could also disadvantage junior creditors by limiting their ability to veto an organization plan and delay the reorganization process.

The empirical literature has examined other reforms undergone by the US bankruptcy procedure, most notably the 1978 Bankruptcy Reform Act[3] and the 2005 Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA). Franks & Torous (1989), Bebchuk (2002), and Adler et al. (2013), among others, find that the 1978 Bankruptcy Reform Act induced lower bankruptcy costs and stronger ex ante debtor protection, which caused more distressed firms to seek protection under Chapter 11. But these authors also document a lengthy and costly reorganization process, with frequent deviations from the APR. Teloni (2015) shows that the BAPCPA resulted in shorter Chapter 11 cases, and at the same time, increased the reliance of firms on prepackaged Chapter 11. The author also notes an increase in the fraction of firms that soon refile for Chapter 11. Warren & Westbrook (2008), however, find that the 2005 reform produced little effect on the length of the Chapter 11 procedure.

By contrast to such ex post investigations, we study the potential consequences of the redemption option by relying on a contingent-claims model of the financially distressed firm.[4] Following Annabi, Breton & François (2012), we analyze Chapter 11 negotiations as a non-cooperative game played between three classes

[1] These studies include, but are not limited to, Bris, Welch & Zhu (2006), Kalay, Singhal & Tashjian (2007), Bharath, Panchapagesan & Werner (2014).

[2] On December 8 2014, the American Bankruptcy Institute, a nonpartisan group established in 1982 to advise Congress, published its final report and recommendation to revise Chapter 11 of the US Bankruptcy Code. If approved by legislators, this would be the first major reform since the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA).

[3] The Bankruptcy Reform Act of 1978 turned Chapter 11 into a consolidation of former Chapters 8–12 of the Bankruptcy Act, and marked the genesis of the modern US Bankruptcy Code.

[4] Contingent-claims models of the leveraged firm, initially developed by Merton (1974) and Leland (1994), have been applied to the bankruptcy procedure by François & Morellec (2004), Galai, Raviv & Wiener (2007), and Broadie, Chernov & Sundaresan (2007), among others.

of claimants (equity holders and senior and junior creditors). Our model is then adapted to the situation where the redemption option reform is implemented: as the distressed firm files for bankruptcy, junior creditors are offered the redemption option value and exit the negotiation game, while equity holders and senior creditors bargain over the remaining value of the firm.

Our main findings are the following. As expected, the redemption option reduces the duration of the bankruptcy procedure and the total bankruptcy costs. However, it results in an increase in the risk of liquidation, as senior creditors and equity holders are left in a more difficult position to negotiate a reorganization agreement. While the overall fairness of the bankruptcy procedure is slightly improved, the ABI reform operates a shift in APR violations: those at the expense of senior creditors become the most frequent. As a matter of fact, the redemption option, as it is currently designed, appears to be too generous a compensation for junior creditors, who are paid in full in most scenarios. Our policy recommendation is twofold. First, the redemption option should not be systematically offered to junior creditors, but only when its wealth transfers are reasonable and its welfare impact is positive. According to our model, these conditions are met when the weight of junior debt in the bankrupt firm's total debt is low. Second, the design of the redemption option should be revised to lower its value. Our numerical simulations indicate that reducing the option maturity is not enough. A solution could consist of reducing the moneyness of the option by increasing its strike price.

The remainder of the paper is structured as follows: Section 2 reviews the game-theoretic model of Annabi et al. (2012) and presents the modifications embodying the redemption option reform proposal. The solution of the negotiation game, with or without the reform, is detailed in Section 3. Section 4 analyzes the impact of introducing the redemption option on the outcomes of the bankruptcy procedure. Section 5 is a conclusion.

2 The Chapter 11 procedure

In this section, we model the Chapter 11 procedure, before and after the proposed reform, in a sequential game framework. This sequential game consists of successive negotiation rounds between the claimants of a defaulted firm, under the supervision of a bankruptcy judge, in the spirit of the model of Annabi et al. (2012). Accordingly, the negotiation process under Chapter 11 is divided into successive rounds, in each of which one class of claimants is responsible for submitting a reorganization plan for the other claimants' approval. At the end of each negotiation round, a reorganization plan is put to a vote, leading to one of the three following outcomes:

- Reorganization (R): the firm is reorganized and emerges as a new entity, which is shared between the claimants;
- Liquidation (L): the firm's assets are liquidated and it ceases to exist;
- Continuation (C): nothing is resolved and the process moves to the next negotiation round, where another class of claimants is selected to propose a new reorganization plan.

2.1 The firm's time line

We consider a continuous-time arbitrage-free economy, and a firm originally financed by two classes of debt (senior and junior) and with equity outstanding. At date $t = 0$, the firm is in default and files for Chapter 11. The value of the firm's assets is driven by the following risk-neutral dynamics:

$$dV_t = \begin{cases} rV_t dt + \sigma V_t dZ_t & \text{if } 0 \leq t < t^* \\ (r - \delta) V_t dt + \sigma V_t dZ_t & \text{if } t^* \leq t < T \end{cases} \tag{1}$$

where r denotes the risk-free rate, δ the dividend payout rate, and σ the volatility of the assets, and where Z_t is a Brownian motion, t^* is the reorganization date (if the firm emerges from the Chapter 11 procedure), and T is the date of a future financial distress event, which is assumed to eventually occur after t^*.

During the Chapter 11 procedure, that is, during the time period $[0, t^*]$, coupon and dividend payments are suspended. The procedure also entails financial distress costs (legal fees, decrease in productivity, loss of business opportunities, etc.) during this period. We model the financial distress costs as a fixed amount θ

that is paid at the beginning of each negotiation round, which rounds are assumed to be of equal duration d. Equation (1) captures the dividend suspension, but not the financial distress costs, which are fixed deterministic jumps at dates $0, d, 2d, 3d$, etc.

In the event that the Chapter 11 procedure leads to liquidation at some date $t^{\#} < t^{*}$, Equation (1) is used to model the dynamics of the firm's assets until $t^{\#}$, where liquidation costs are assumed to be a fraction α of the remaining assets at $t^{\#}$.

2.2 The players

As in Annabi et al. (2012), we identify single players, denoted respectively by e, s, and j, with the equity holders (Player e) and with two classes of creditors, labeled senior (Player s) and junior (Player j). The renegotiation process involves the three strategic players, e, s, and j, who make their decisions independently by taking into account their best individual interest, and the bankruptcy judge, who is a non-strategic player. Let $I = \{e, s, j\}$ represent the set of strategic players.

We assume that the bankruptcy judge can intervene at the end of each negotiation round, either to impose (cramdown) the proposed plan or to declare the firm's liquidation. As stipulated by the Bankruptcy Code, a plan imposed by the judge should be "fair and equitable" (paragraph 1129 of the US Bankruptcy Code). Moreover, liquidation can be imposed by the judge in "the absence of a reasonable likelihood of rehabilitation" (paragraph 1112 of the US Bankruptcy Code). Accordingly, we assume that the bankruptcy judge intervenes when there is at least one class of claimants that does not agree with the proposed reorganization plan, that liquidation can be declared when all classes of claimants reject the proposed reorganization plan, and that the likelihood of a judge deciding to cramdown a reorganization plan is related to the relative fairness of that plan with regard to each claimant's claim and priority.

Empirical evidence indicates that the propensity to intervene during the Chapter 11 procedure varies significantly among bankruptcy judges (see, e.g., Chang & Schoar, 2006). We therefore assume that the probability that the bankruptcy judge will intervene depends on one parameter, denoted Z, that is specific to the judge and known by all claimants at date 0.

2.3 The reorganization plan

A reorganization plan consists of a new, reorganized coupon vector $c = (c_s, c_j)$. To assess a reorganization plan's fairness at some given date t, we evaluate what share each player would get if this plan were adopted, with respect to the amount and priority of the player's claim.

Let $\omega_i^L(v)$ denote the liquidation value for Player i under the APR when the value of the firm's assets $V_t = v$. Let $\omega_i^R(v, c)$ denote the reorganization value for Player i under the coupon vector c when $V_t = v$.

We define the relative unfairness of a reorganization plan characterized by a coupon vector c at a given $V_t = v$ by the normalized distance[5]

$$u(v, c) = \min\left\{ \frac{\sum_{i \in I} \left(\left[\omega_i^L(v) - \omega_i^R(v, c) \right]^+ \right)^2}{\left(\max_{i \in I} \left\{ \omega_i^L(v) \right\} \right)^2}, 1 \right\}.$$

When a class of claimants submits a reorganization plan c to the other claimants, reorganization according to c can happen if the plan is accepted by all claimants or if the plan is imposed by the judge. The probability of a plan c being imposed by cramdown at $V_t = v$ is given by

$$z(v, c) = Z\left(1 - u(v, c)\right),$$

where $Z \in [0, 1]$ depends on the judge's propensity to intervene, and $1 - u(v, c) \in [0, 1]$ is a measure of the fairness of the reorganization plan c at $V_t = v$.

[5] Carapeto (2006) uses a similar metric to assess the unfairness of the bankruptcy outcome.

2.4 A three-player sequential game

In accordance with the current Chapter 11 bargaining rules, the game is played as follows. At a given date $t = kd$, where k indexes the negotiation round, a claimant (labeled *Leader*) proposes a reorganization plan, and the other two claimants (labeled *Follower 1* and *Follower 2*) vote on it. Exhibit 1 depicts the normal-form representation of the game at the end of negotiation round k when the plan proposed by the leader is c and when $V_t = v$ at $t = kd$. Under the Debtor-In-Possession (DIP) rule, the first round is led by Player e. We assume a maximum of three negotiation rounds, where the second round is led by Player s, and where Player j leads the last negotiation round. We further assume that the firm's assets are liquidated after three rounds or when they are not sufficient to cover the financial distress costs of an additional round.

Exhibit 1: Normal-form representation of the negotiation-round game under the current Chapter 11 procedure.

	Follower 2	
Follower 1	Accept	Reject
Accept	$\omega^R(v,c)$	$z(v,c)\,\omega^R(v,c) + (1-z(v,c))\,\omega^C(v,k)$
Reject	$z(v,c)\,\omega^R(v,c) + (1-z(v,c))\,\omega^C(v,k)$	$Z\omega^L(v) + (1-Z)\,\omega^C(v,k)$

This exhibit shows the outcomes of a negotiation game at any given round k when the leader proposes a reorganization plan c to Followers 1 and 2. Note that $\omega^C(v,k) = \omega^L(v)$ when $k = 3$ or when $v \leq \theta$.

In Exhibit 1, the vectors $\omega^R(v,c)$ and $\omega^L(v)$ respectively contain the reorganization values and the liquidation values for the three players at (v,c), while the vector $\omega^C(v,k)$ contains the continuation value for each player if nothing is resolved at negotiation round k.

These are then the possible outcomes of a negotiation round:

- Restructuring under plan c, if both followers accept the plan or if the judge imposes it (with probability $z(v,c)$);
- Liquidation, if the plan is rejected by both followers and the judge imposes liquidation (with probability Z), if the value of the firm's assets is lower than the financial distress costs of an additional round, or if nothing is resolved after three negotiation rounds;
- Continuation to the next round, if at least one of the followers rejects the plan and if the judge does not intervene, provided that an additional round is possible.

In each round, the leader proposes a plan c that maximizes his or her own expected outcome given the equilibrium reaction of the two followers to any proposal, according to a leader-follower (Stackelberg) equilibrium framework. The two followers decide independently, without communication, whether to accept or reject the proposed plan, in a Nash equilibrium framework.

2.5 A two-player leadership game

Under the current form of Chapter 11, any class of claimants can veto the reorganization plan, for instance by arguing that the plan is impaired, i.e., that claimants receive less than they would be entitled to if APR were strictly enforced. The reform put forward by the ABI aims exactly at ending such delay tactics. The proposed reform consists of accelerating the resolution of financial distress in the first round (that is, when equity holders have the lead). Junior creditors are offered a redemption option, which is a call option on the firm's assets with a strike price equal to the senior nominal debt and a maturity $M = 3$ years. Consistent with the asset dynamics described in Equation (1), that call option, at $t = 0$ and $v = V_0$, is worth

$$RO = V_0\Phi(d_1) - \frac{c_s^0}{r}e^{-Mr}\Phi(d_2),$$

with

$$d_1 = \frac{\ln\frac{rV_0}{c_s^0} + M\left(r + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{M}}, \qquad d_2 = \frac{\ln\frac{rV_0}{c_s^0} + M\left(r - \frac{\sigma^2}{2}\right)}{\sigma\sqrt{M}},$$

where $M = 3$, c_s^0 is the senior contractual coupon and $\Phi(.)$ is the standard normal cumulative distribution function. We assume that the amount ω_j^O offered to the junior creditors cannot be larger than the contractual

junior debt, that is,

$$\omega_j^O = \min\left\{RO, \frac{c_j^0}{r}\right\},$$

where c_j^0 is the junior contractual coupon. The junior creditor accepting the redemption option value no longer participates in the negotiation process, which then leaves only two players (the equity holder and the senior creditor).

Accordingly, under the ABI reform, a negotiation round consists of a proposal by the leader, which can be accepted or rejected by the other player. Exhibit 2 then shows the normal-form representation of the negotiation game between the two remaining players (assuming that the junior creditors have accepted the redemption option), when the plan proposed by the leader is c and when $V_t = v$ at $t = kd$. We assume that the first round is led by Player e. The second round is then led by Player s; and Player e is the leader of the final negotiation round.

Exhibit 2: Normal-form representation of the negotiation-round game under the proposed Chapter 11 reform.

	Follower
Accept	Reject
$\omega^R(v,c)$	$z(v,c)\,\omega^R(v,c) + (1 - z(v,c))\,\omega^C(v,k)$

This exhibit shows the outcomes of a negotiation game at any given round k when the Leader proposes a reorganization plan c to the Follower. Note that $\omega^C(v,k) = \omega^L(v)$ when $k = 3$ or when $v \leq \theta$.

The possible outcomes of a negotiation round are then as follows:

- Restructuring under plan c, if the follower accepts the plan or if the judge imposes it (with probability $z(v,c)$); the restructured firm then has only one class of claimants;
- Continuation to the next round, if the follower rejects the plan and if the judge does not intervene, provided an additional round is possible;
- Liquidation, if restructuring has not been achieved after three negotiation rounds, or if the firm's assets are not sufficient to cover the financial distress costs. Proceeds of the liquidation are divided between the senior creditor and the equity holders.

In each round, the leader proposes a plan c that maximizes his or her own expected outcome, given the reaction of the follower to any proposal, according to a leader-follower equilibrium framework.

3 Solving the negotiation game

In this section, we solve for the equilibrium strategies of the strategic players involved in renegotiating the debt.

3.1 Outcome values

We first compute the value of what each claimant receives according to the outcome of the negotiation process at given dates $t = kd$ corresponding to the end of negotiation rounds k, $k = 1, ..., 3$.

The mathematical expressions for the vector $\omega^L(v)$ under the APR are recalled in Appendix A.

The value of the vector $\omega^R(v,c)$ with asset dynamics given in (1) is computed by considering that a firm emerging from financial distress at $(t, V_t = v)$ under a reorganization plan c will continue its operations until further default at date T. As in Annabi et al. (2012), we assume that a further default by the reorganized firm eventually leads to liquidation, and that the decision to liquidate is made by the equity holders. The reorganization values for each claimant under plan c can then be obtained from the Leland (1994) model and are recalled in Appendix A.1.

Finally, we compute the continuation values at date $t = kd$ and at net asset value v as the expected discounted value of the players' future equilibrium payoffs, taking into account the dynamics of the firm's net asset value, including a deterministic jump of $-\theta$ at date kd, that is,

$$C_i(v,k) = e^{-rd}\mathbb{E}_{kd}\left[\omega^*\left(V_{(k+1)d}, k+1\right)\right],$$

where $\omega^*(v,k)$ is the vector of equilibrium outcomes of negotiation round k when the firms' net asset value is v, and $\mathbb{E}_t[\cdot]$ denotes the expected value given the information available at date t. We then have

$$\omega_i^C(v,k) = \begin{cases} \omega^L(v) \text{ if } v \leq \theta \text{ or for } k = 3 \\ C_i(v,k) \text{ otherwise.} \end{cases} \tag{2}$$

3.2 Negotiation round

We now solve the game at a given negotiation round: first under the proposed reform and then under the current Chapter 11 procedure.

According to the proposed reform, by accepting the redemption option value, junior claimants are no longer involved in the negotiation process. As a result, a negotiation round is modeled as a Stackelberg game, where the player proposing a reorganization plan is the leader (labeled $l \in \{e,s\}$), where the other claimant (labeled f) can either accept or reject the plan, and where the corresponding payoffs are given in Exhibit 2.

Proposition 1 *At a given negotiation round k, if the leader is Player $l \in \{e,s\}$ and the other player is Player f, the equilibrium outcome at v is given by*

$$\omega^*(v,k) = \begin{cases} \omega^R\left(v, c^\sharp\right) & \text{if } O_A \geq O_R \\ z\left(v,c^\flat\right)\omega^R\left(v,c^\flat\right) + \left(1 - z\left(v,c^\flat\right)\right)\omega^C(v,k) & \text{otherwise} \end{cases}$$

where $c^\sharp = \left(c^\sharp, 0\right)$ solves

$$\begin{aligned} O_A &= \max_c \left\{\omega_l^R(v,c)\right\} \\ &s.t. \\ &\omega_f^R(v,c) \geq \omega_f^C(v,k) \end{aligned} \tag{3}$$

and $c^\flat = \left(c_s^\flat, 0\right)$ solves

$$\begin{aligned} O_R &= \max_c \left\{z(v,c)\,\omega_l^R(v,c) + (1 - z(v,c))\,\omega_l^C(v,k)\right\} \\ &s.t. \\ &\omega_f^R(v,c) < \omega_f^C(v,k) \end{aligned} \tag{4}$$

Proof. In the first case, coupon $c^\sharp$ optimizes the reorganization value for the leader, from the set of all coupon values that would be accepted by the follower. Otherwise, coupon $c^\flat$ optimizes the expected outcome of the negotiation game for the leader, from the set of all coupon values that would be rejected by the follower, accounting for the fact that the judge might decide to impose the proposed plan, with a probability $z\left(v,c^\flat\right)$, or allow an additional negotiation round. □

When all three players are involved in the negotiation process, a negotiation round is modeled as a Stackelberg game, where the leader (labeled $l \in \{e,s,j\}$) chooses his or her plan by taking into account the Nash equilibrium between the other two claimants (labeled f_1 and f_2), where the corresponding payoffs are given in Exhibit 1.

Proposition 2 *At a given negotiation round k, if the leader is Player $l \in \{e,s,j\}$ and the other players are Players f_1 and f_2, the equilibrium outcome at v is given by*

$$\omega^*(v,k) = \begin{cases} \omega^R\left(v, c^\sharp\right) & \text{if } O_{AA} \geq \max\{O_{RR}, O_{RA}\} \\ Z\omega^L(v) + (1-Z)\,\omega^C(v,k) & \text{if } O_{RR} > \max\{O_{AA}, O_{RA}\} \\ z\left(v,c^\flat\right)\omega^R\left(v,c^\flat\right) + \left(1 - z\left(v,c^\flat\right)\right)\omega^C(v,k) & \text{otherwise} \end{cases}$$

where

$O_{RR} = Z\omega_l^L(v) + (1-Z)\,\omega_l^C(v,k)$,

$c^\sharp$ *solves*

$$\begin{aligned} O_{AA} &= \max_c \left\{\omega_l^R(v,c)\right\} \\ &s.t. \\ &\omega_{f_i}^R(v,c) \geq \omega_{f_i}^C(v,k), \quad i=1,2 \end{aligned} \tag{5}$$

and $c^\flat$ *solves*

$$\begin{aligned} O_{RA} &= \max_{c,j} \left\{z(v,c)\,\omega_l^R(v,c) + (1-z(v,c))\,\omega_l^C(v,k)\right\} \\ &s.t. \\ &\omega_{f_j}^C > \frac{Z\omega_{f_j}^L(v) - z(v,c)\,\omega_{f_j}^R(v,c)}{Z - z(v,c)} \\ &\omega_{f_i}^R(v,c) < Z\omega_{f_i}^L(v) + (1-Z)\,\omega_{f_i}^C(v,k) \\ &j \in \{1,2\}, i = 3-j \end{aligned} \tag{6}$$

Proof. In the first case, coupon $c^\sharp$ optimizes the reorganization value for the leader from the set of all coupon values that would be accepted by both followers. In the second case, the leader chooses any coupon leading both followers to reject the reorganization plan. In the third case, the leader optimally chooses one follower (j) and a coupon $c^\flat$ that optimizes the expected outcome of the negotiation game from the set of all coupon values that would be accepted by follower j and rejected by the other follower, accounting for the fact that the judge might decide to impose the proposed plan with a probability $z\left(v,c^\flat\right)$ or allow an additional negotiation round. The leader then chooses the best outcome among the three possible cases. □

Note that the solution at a given negotiation round involves the continuation value, which requires the equilibrium solution at the next negotiation round. Accordingly, the game is solved by backward recursion, starting with the last negotiation round ($k=3$) where the continuation value is known, $\omega^C(v,3) = \omega^L(v)$. In our implementation, the equilibrium outcomes are computed on a finite grid of asset values and are then interpolated using linear splines to obtain piecewise linear continuous equilibrium outcome functions. Continuation values can then be obtained analytically. Optimization problems (3)–(6) are then solved over a finite grid of coupon values.

4 Results

We examine the wealth transfers induced by the bankruptcy procedure by investigating the creditors' recovery and the frequency of APR violations. Recovery is calculated for both senior and junior creditors as

$$\frac{\omega_i^R(v,c)}{c_i/r}, i \in \{s,j\}.$$

In terms of APR violations, we distinguish between two situations: The first type of APR violation (type I) occurs when the senior creditors recover less than the nominal value of their claim while junior creditors receive a non-trivial payoff, that is, when

$$\omega_s^R(v,c) < \tfrac{c_s}{r} \quad \text{and} \quad \omega_j^R(v,c) > 0.$$

The second type of APR violation (type II) occurs when the junior creditors recover less than the nominal value of their claim while equity holders receive a non-trivial payoff, that is, when

$$\omega_j^R(v,c) < \tfrac{c_j}{r} \quad \text{and} \quad \omega_e^R(v,c) > 0.$$

We compute the frequency at which each of these APR violation types occurs, as well as the frequency at which any violation occurs.

4.1 Model parametrization

We need to parametrize our model to perform numerical experiments. Table A.1 reports the firm-specific (panel A) as well as Chapter 11–specific (panel B) parameter values.

Firms entering into bankruptcy display a relatively high operational risk and leverage. Consistent with the empirical estimates reported in Annabi et al. (2012), Davydenko (2012) and Davydenko, and Strebulaev & Zhao (2012), the asset volatility parameter σ is set between 10% and 50% and the quasi-market leverage ratio L ranges from 80% to 125%.[6] The tax advantage of debt is measured using a marginal corporate tax rate estimated at 30% (Graham & Mills, 2008). The payout rate is set at 2% (Kahle & Stulz, 2017).

Bankrupt firms, however, do not exhibit any specific pattern insofar as debt priority structure is concerned. Therefore we examine a wide spectrum of senior and junior coupons: mostly junior, with $(c_s, c_j) = (2, 8)$; balanced, with $(c_s, c_j) = (5, 5)$; or mostly senior, with $(c_s, c_j) = (8, 2)$.

We now turn to Chapter 11–specific parameters. The first round of the Chapter 11 procedure lasts a minimum of 180 days and can be extended up to 20 months (see paragraph 1121 (d) of the US Bankruptcy Code). Accordingly, we assume that all negotiation rounds have an equal duration of 2 years. We set the maximum number of rounds to 3, to allow each claimant to propose a plan once. Accordingly, the Chapter 11 procedure may not exceed 6 years, which is in line with the maximum duration for Chapter 11, reported in Bris et al. (2006). We match the liquidation costs with the mean expenses incurred by firms filing Chapter 7, as reported in Bris et al. (2006).

Finally, we determine the range for the judge's propensity to intervene Z and for the costs of financial distress θ, so as to be consistent with the observed frequency of senior and junior creditor recovery and of APR violations. After testing for a wide range of possibilities, the values $Z = 0.7$ and $\theta = 20$ yield the closest matches. Table A.2 reports the outcomes of that parameterization, which accounts for variations in risk, leverage, and debt priority structure of the bankrupt firms.[7]

4.2 The ABI reform and creditor recovery

Junior and senior creditor recoveries are reported in Tables A.3 and A.4, respectively. Different leverage ratios, volatility levels, and debt priority structures are investigated. We also vary the maturity M of the redemption option. The proposed reform suggests granting junior creditors a three-year redemption option. We examine the cases of a shorter ($M = 1$ year) or a longer ($M = 5$ years) redemption option maturity. The junior and senior creditor recoveries are compared to the ones prevailing under the current bankruptcy procedure, i.e., in the absence of any reform (indicated in the column where $M = 0$).

One goal of the reform is to withdraw junior creditors from the bargaining process by granting them adequate compensation. Our numerical investigations in Table A.3 indicate that the proposed compensation appears very generous. For low- and medium-leverage firms, the value of the redemption option actually exceeds the initial junior debt nominal, thereby guaranteeing full recovery. This holds for all levels of volatility considered, no matter what the debt priority structure is. Only for highly leveraged firms are the junior creditors recovering less than their full claim value. But even in that case, the redemption option they receive allows them to substantially improve their recovery rate (the lowest junior recovery for highly leveraged firms is 63% under the proposed reform, while it does not exceed 38% under the current process). We note that shortening the redemption option maturity does not significantly reduce the junior recovery rate, except in the case of low-risk, high-leverage firms.

Table A.4 shows that the redemption option induces a wealth transfer benefiting junior creditors, at the expense of senior creditors. The loss experienced by senior creditors is particularly severe when senior debt represents a small fraction of the total debt (panel A). Under that debt priority structure, senior creditors take advantage of playing a three-player game under bankruptcy. They manage to extract recovery rates

[6] In our model, the quasi-market leverage ratio is given by $L = (c_s + c_j)/rV_0$. Setting the total coupon $c_s + c_j = 10$, we use $V_0 = 250$, $V_0 = 200$, and $V_0 = 160$ to obtain the corresponding leverage levels of $L = 0.8$, $L = 1$, and $L = 1.25$.

[7] Results for alternative values of Z and θ are available upon request.

higher than 100% because their vote is instrumental in the adoption of the reorganization plan. By contrast, the proposed reform leaves senior creditors as the sole debtholders to negotiate with equity holders. If their weight in the initial capital structure is small (panel A), they find themselves in a weak bargaining position and therefore recover much less than under the current bankruptcy procedure. If, however, most of the total debt is senior (panel C), the reduction in the senior recovery rate caused by the reform is moderate (for instance, the senior recovery rate drops from to 62% to 51% for medium-risk, medium-leverage firms). Finally, we note that senior creditors are relatively more harmed by the redemption option when leverage and risk are high.

4.3 The ABI reform and APR violations

On top of offering generous compensation to junior creditors, the introduction of the redemption option also increases the frequency of APR violations. Results in Table A.5 indicate that, in many instances, junior creditors receive the value of the redemption option, where they would be entitled to nothing if the APR were enforced.

As a matter of fact, the type I APR violation is a relatively minor phenomenon with the current procedure. Its frequency hardly exceeds 30% of bankruptcy cases in empirical studies, and it is calibrated to 39% of cases in our model for a medium-risk, medium-leverage firm with a balanced debt priority structure. However, the introduction of the redemption option makes type I APR violations become the rule rather than the exception, with a frequency above 70% of cases for most types of bankrupt firms.

As shown in Table A.5, the only situation where the reform actually decreases the frequency of type I APR violations is when the bankrupt firm has a low risk, low leverage, and little senior debt in its capital structure. This corresponds to the case where the redemption option's value is small.

When both types of APR violations are taken into account, the effect of the reform appears more positive, as illustrated in Table A.6. In the current application of Chapter 11, the rights of senior creditors are fairly well protected (low frequency of type I APR violations), but those of junior creditors are often violated to the benefit of equity holders (type II APR violations). As a result, empirical studies document a high frequency of overall APR violations (either type I or II), ranging between 70% and 80% of cases. Although the calibration of our model slightly overstates that frequency, our numerical experiments indicate that introducing the redemption option actually reduces the occurrence of APR violations. The only exception is found for bankrupt firms with a low risk and high leverage, which occurs only in rare instances.

In sum, if the redemption option clearly induces a wealth transfer at the expense of senior creditors, it also improves the overall fairness of the bankruptcy procedure, judging by the frequency of either type I or type II APR violations.

4.4 The ABI reform and liquidation

The liquidation rate is another important factor in gauging the welfare effects of the bankruptcy reform. The Chapter 11 procedure traditionally has made a priority of maintaining bankrupt firms as going concerns. As a matter of fact, empirical studies of US bankruptcy outcomes report a relatively low liquidation rate (between 15% and 30%, according to these studies: Carapeto 2006, Bris et al. 2006, Kalay et al. 2007, and Jiang et al. 2012). The main justification for avoiding the liquidation outcome is the significant associated economic costs, which have been put forward theoretically (Shleifer & Vishny 1992) and documented empirically (Bris et al. 2006), as well as the social costs induced by mass layoffs.

Table A.7 reports the liquidation probabilities generated by our model, with and without the redemption option. Recall that, in our model, liquidation may occur during intermediary negotiation rounds if the firm cannot cover the costs of financial distress. It can also happen at the final negotiation round if no reorganization plan has been adopted. And finally, it may also be triggered by the judge's intervention. The liquidation state is thus determined by critical thresholds for the value of assets at the end of each round. Given that the value of assets starts at level V_0 and then evolves according to Equation (1), we can compute

the probability that the asset value will hit one of those critical thresholds. Then, by adding the exogenous probability of the judge's intervention to liquidate, we can determine the overall likelihood of liquidation.

The redemption option has two impacts on the liquidation probability. First, it should provide immediate debt relief for the firm, as the debt burden is reduced by the amount of junior debt nominal. However, we find that in most cases, the value of the redemption option exceeds the junior debt nominal. Thus, junior creditors are paid back in full, and the firm does not benefit from any debt forgiveness.[8] Second, the redemption option reduces the bargaining process to a two-player game between equity holders and senior creditors. This has an ambiguous impact on the probability of liquidation: On the one hand, it may seem harder for the negotiation leader to propose a plan that will please two classes of claimholders rather than one. Thus, the redemption option simplifies the negotiation game and should lower the likelihood of an agreement not being reached by the parties (leading to liquidation). On the other hand, a leader dealing with two claimants can strategically propose a plan that is close to being fair to all parties without making too many concessions.[9] By doing so, the leader increases the chances of a cramdown being imposed by the judge, thereby avoiding liquidation.

The numerical experiments reported in Table A.7 show that the ABI reform reduces the likelihood of liquidation for firms that have a mostly senior debt structure (Table A.7, panel C) and for firms combining a low leverage and low risk. By contrast, firms with a mostly junior debt structure (Table A.7, panel A) are forced by the redemption option to repay a large portion of their debt at full price, and are left little room to renegotiate the remaining senior debt. The ABI reform is particularly detrimental to those firms, as the liquidation probability exceeds 40% in some cases.

4.5 The ABI reform and bankruptcy costs

As a final assessment of the ABI reform, it is interesting to measure the change in bankruptcy costs (i.e., the sum of financial distress and liquidation costs) when the redemption option is introduced.

As is clearly the intent of the reform, the duration of Chapter 11 is reduced with the redemption option. In our model, the redemption option transforms a three-player sequential game that may last up to three rounds (6 years) into a two-player leadership game with a single round resolution (2 years). Given that our model parametrization yields $\theta = 20$, we obtain proportional costs of financial distress of roughly 10% of the initial asset value. Hence, the maximum reduction in these costs is 40% of the initial asset value.

Turning to liquidation costs, we set $\alpha = 8\%$, in line with empirical studies. That fraction applies to the value of assets upon liquidation, which may be much lower than the initial asset value V_0. If we consider the cases examined in Table A.7 to be equiprobable, we obtain an average liquidation probability of 4% under the current procedure, and of 9% under the ABI reform (with a 3-year redemption option maturity). Hence the maximum increase in liquidation costs can be estimated at 5% of the initial asset value. We therefore conclude that the ABI reform significantly reduces bankruptcy costs, as the effect of shortening the duration of Chapter 11 more than offsets the increase in the liquidation rate.

5 Conclusion

As initially put forward by Aghion, Hart & Moore (1992), the design of a bankruptcy procedure is a nontrivial issue, with significant and complex economic repercussions on the firm, the wealth of its claimholders, and welfare in general. The reform put forward by the ABI aims at accelerating the costly bankruptcy procedure by offering an exit strategy to junior creditors, who are often victims of APR violations.

We have proposed a game-theoretic, continuous-time framework for assessing the costs and benefits of introducing a redemption option in the resolution of financial distress under Chapter 11. Our conclusions regarding the impacts of the reform are mixed. As expected, the redemption option shortens the duration of the procedure and decreases the overall bankruptcy costs. But we also find that the redemption option, in the way it is currently designed, induces a wealth transfer that is clearly at the expense of senior creditors. Even

[8] These cases are in fact equivalent to the early repayment of junior debt.

[9] By contrast, in a two-player game, any concession given to the follower is a loss for the leader.

if the overall fairness of the bankruptcy procedure is slightly improved, the ABI reform essentially consists of substituting one form of injustice (APR violation type I) with another (APR violation type II). We finally note that the reform increases the liquidation rate of the bankruptcy procedure, which induces a social cost that is difficult to measure.

Our analysis points towards two main policy implications. First, the redemption option should not be automatically granted to the junior creditors of a bankrupt firm. Rather, it should be applied only when the wealth transfer it induces at the expense of senior creditors is moderate, and when the overall fairness of the bankruptcy procedure is maintained. Our approach suggests that these conditions are met when the bankrupt firm has a mostly senior debt priority structure. Second, the proposed design of the redemption option should be revised. We argue that this option is currently too valuable, and we have shown that shortening its maturity does not change much. A more effective solution would be to decrease its moneyness by setting the strike price above the senior debt nominal.

Our model is a first attempt at gauging the economic consequences of a change in bankruptcy design. It can be improved in several respects, including through a more sophisticated description of asset value dynamics, a higher number of classes of claimants, and a more precise modeling of the judge's behavior. This is left for future research.

Appendix A Liquidation values

If the firm is liquidated at date t and net asset value $v = V_t$, then the assets of the firm, net of the financial distress costs, are disposed of at a proportional liquidation cost α, and the liquidation value of the firm is

$$\omega_F^L(v) = \max\left[(1-\alpha)\, v, 0\right]. \tag{7}$$

According to the APR, the liquidation value vector $\omega^L(v) = \left(\omega_s^L(\cdot), \omega_j^L(\cdot), \omega_e^L(\cdot)\right)$ is then given by

$$\omega_s^L(v) = \min\left[\omega_F^L(v), \frac{c_s^0}{r}\right], \tag{8}$$

$$\omega_j^L(v) = \min\left[\max\left[\omega_F^L(v) - \frac{c_s^0}{r}, 0\right], \frac{c_j^0}{r}\right], \tag{9}$$

and

$$\omega_e^L(v) = \max\left[\omega_F^L(v) - \frac{c_s^0 + c_j^0}{r}, 0\right]. \tag{10}$$

When the firm is liquidated after the junior creditor has accepted the value of the redemption option and forfeited his or her right to participate in the restructuring process, the liquidation vector is obtained by setting $c_j^0 = 0$, which yields $\omega_j^L(v) = 0$.

A.1 Reorganization values

We assume that the reorganized firm continues operating until the asset value hits the level B for the first time. If the decision to liquidate is made by equity holders, then the optimal liquidation barrier is (see Leland, 1994)

$$B = \frac{(1-\tau)\,\lambda}{r}\left(c_s + c_j\right),$$

where τ denotes the corporate tax rate and $\lambda = \frac{\gamma+\eta}{\gamma+\eta+\sigma}$ with $\gamma = \left(r - \delta - \frac{\sigma^2}{2}\right)/\sigma$ and $\eta = \sqrt{2r+\gamma^2}$.

In this setup, all contingent claims written on v can be valued using the fact that the present value of \$1 contingent on liquidation is given by $p \equiv \left(\frac{B}{v}\right)^{\frac{\lambda}{1-\lambda}}$. The value at (v, c) of the reorganized firm is then given by

$$\omega_F^R(v, c) = v + \frac{\tau\left(c_s + c_j\right)}{r}(1-p) - \alpha B p, \tag{11}$$

where the second and third terms of Equation (11) account for the tax advantage of debt and the liquidation costs, respectively.

Similar computations yield the vector of reorganization values $\omega^R(v,c)$:

$$\omega_s^R(v,c) = \frac{c_s}{r}(1-p) + \min\left[(1-\alpha)B, \frac{c_s}{r}\right]p \tag{12}$$

$$\omega_j^R(v,c) = \frac{c_j}{r}(1-p) + \min\left[\max\left[(1-\alpha)B - \frac{c_s}{r}, 0\right], \frac{c_j}{r}\right]p \tag{13}$$

$$\omega_e^R(v,c) = v - (1-\tau)\frac{c_s+c_j}{r}(1-p) - Bp \tag{14}$$

When the firm is reorganized after the junior creditor has accepted the value of the redemption option and forfeited his or her right to participate in the restructuring process, the reorganization vector is obtained by setting $c_j = 0$, yielding $\omega_j^R(v,c) = 0$.

Appendix B Tables

Table A.1: Base case parameter values. This table reports base case values for the firm-specific and Chapter 11–specific parameters. Firm-specific parameters reflect the typical asset value dynamics and capital structure of firms entering into Chapter 11 bankruptcy. The Chapter 11–specific parameters d and K account for the typical number and duration of negotiation rounds. The Chapter 11–specific parameters Z and θ are set to jointly match the liquidation frequency, creditors' recovery, and APR violation frequency (see Table A.2).

	Notation	Base value / range
Risk-free interest rate	r	5%
Panel A: Firm-specific parameters		
Asset return volatility	σ	$10\% - 50\%$
Asset value at entry of Chapter 11 ($)	V_0	$160 - 250$
Tax advantage of debt after emergence	τ	30%
Payout rate after emergence	δ	2%
Senior and junior coupons ($)	(c_s, c_j)	$(2,8), (5,5), (8,2)$
Panel B: Chapter 11–specific parameters		
Length of a negotiation round (years)	d	2
Maximum number of negotiation rounds	K	3
Proportional liquidation costs	α	8%
Judge's propensity to intervene	Z	0.7
Financial distress costs ($)	θ	20

Table A.2: Fit on the current bankruptcy procedure. This table reports the creditor recoveries and APR violation frequencies obtained for bankrupt firms with different debt priority structures, risk, and leverage. The judge's propensity to intervene is set to $Z = 0.7$ and the costs of financial distress are set to $\theta = 20$. All values are reported in percentage points. Targets are average values found in the empirical literature, including Weiss (1990), Betker (1995), Tashjian et al. (1996), Bris et al. (2006), Carapeto (2006, 2007), Jiang et al. (2012), and Capkun & Weiss (2016).

		Senior recovery	Junior recovery	APR violation frequency Type I	APR violation frequency All types
	Target	90% - 93%	48% - 52%	12% - 31%	70% - 80%
c_s= 2, c_j= 8					
$L = 1$	$\sigma = 0.1$	123.64	50.54	63.03	92.06
	$\sigma = 0.3$	124.18	41.96	36.21	94.22
	$\sigma = 0.5$	120.18	36.69	47.71	95.74
$\sigma = 0.3$	$L = 0.8$	133.77	54.15	47.10	91.70
	$L = 1.25$	116.05	31.69	30.09	96.78
c_s= 5, c_j= 5					
$L = 1$	$\sigma = 0.1$	99.57	43.90	60.98	92.12
	$\sigma = 0.3$	91.02	38.81	60.32	97.08
	$\sigma = 0.5$	79.26	25.14	75.86	96.92
$\sigma = 30\%$	$L = 0.8$	99.34	49.50	52.60	94.50
	$L = 1.25$	80.07	27.36	74.17	98.82
c_s= 8, c_j= 2					
$L = 1$	$\sigma = 0.1$	71.15	50.72	37.80	93.62
	$\sigma = 0.3$	61.92	40.33	48.75	93.96
	$\sigma = 0.5$	52.65	36.08	65.27	95.83
$\sigma = 0.3$	$L = 0.8$	74.24	51.12	43.95	92.65
	$L = 1.25$	51.43	27.96	58.42	95.72

Table A.3: Junior creditor recovery under current and reformed Chapter 11. This table reports the recovery rates (in percentage points) for the junior debt. Various levels of operational risk (σ), leverage (L), and debt priority structure (c_s, c_j) are considered. Parameter M represents the maturity of the redemption option granted to junior creditors under the proposed Chapter 11 reform. The case $M = 0$ represents the current bankruptcy procedure.

	Junior creditor recovery											
	$\sigma = 0.1$				$\sigma = 0.3$				$\sigma = 0.5$			
M	0	1	3	5	0	1	3	5	0	1	3	5
Panel A: c_s= 2, c_j= 8												
$L = 0.8$	61.88	100	100	100	54.15	100	100	100	48.54	100	100	100
$L = 1$	50.54	100	100	100	41.96	100	100	100	36.69	100	100	100
$L = 1.25$	37.51	76.22	78.48	80.53	31.69	76.22	78.49	80.60	27.31	76.23	79.05	81.93
Panel B: c_s= 5, c_j= 5												
$L = 0.8$	66.83	100	100	100	49.50	100	100	100	27.64	100	100	100
$L = 1$	43.90	100	100	100	38.81	100	100	100	25.14	100	100	100
$L = 1.25$	18.51	64.88	73.93	82.12	27.36	65.50	77.32	87.34	20.80	69.54	87.33	100
Panel C: c_s= 8, c_j= 2												
$L = 0.8$	83.58	100	100	100	51.12	100	100	100	43.89	100	100	100
$L = 1$	50.72	100	100	100	40.33	100	100	100	36.08	100	100	100
$L = 1.25$	17.09	27.22	62.57	93.68	27.96	56.93	100	100	28.20	87.17	100	100

Table A.4: Senior creditor recovery under current and reformed Chapter 11. This table reports the recovery rates (in percentage points) for the senior debt. Various levels of operational risk (σ), leverage (L), and debt priority structure (c_s, c_j) are considered. Parameter M represents the maturity of the redemption option granted to junior creditors under the proposed Chapter 11 reform. The case $M = 0$ represents the current bankruptcy procedure.

	Senior creditor recovery											
	$\sigma = 0.1$				$\sigma = 0.3$				$\sigma = 0.5$			
M	0	1	3	5	0	1	3	5	0	1	3	5
Panel A: c_s= 2, c_j= 8												
$L = 0.8$	141.03	85.04	85.04	85.04	133.77	73.09	73.09	73.09	134.41	58.31	58.31	58.31
$L = 1$	123.64	16.30	16.30	16.30	124.18	22.77	22.77	22.77	120.18	23.67	23.67	23.67
$L = 1.25$	119.35	20.27	23.78	19.15	116.05	21.39	19.13	16.92	106.36	21.85	17.25	12.11
Panel B: c_s= 5, c_j= 5												
$L = 0.8$	106.33	76.05	76.05	76.05	99.34	65.82	65.82	65.82	90.84	53.61	53.61	53.61
$L = 1$	99.57	53.01	53.01	53.01	91.02	49.66	49.66	49.66	79.26	39.87	39.87	39.87
$L = 1.25$	89.43	51.45	48.16	42.17	80.07	46.45	38.97	31.69	67.47	35.84	27.30	20.82
Panel C: c_s= 8, c_j= 2												
$L = 0.8$	82.53	74.25	74.25	74.25	74.24	60.08	60.08	60.08	60.35	51.16	51.16	51.16
$L = 1$	71.15	57.76	57.76	57.76	61.92	50.75	50.75	50.75	52.65	43.87	43.87	43.87
$L = 1.25$	58.10	53.01	46.23	40.84	51.43	45.03	40.01	40.01	44.54	36.12	34.78	34.78

Table A.5: APR violation frequency (type I) under current and reformed Chapter 11. This table reports the frequency of type I APR violations (in percentage points). Various levels of operational risk (σ), leverage (L), and debt priority structure (c_s, c_j) are considered. Parameter M represents the maturity of the redemption option granted to junior creditors under the proposed Chapter 11 reform. The case $M = 0$ represents the current bankruptcy procedure.

	APR violation frequency: Type I											
	$\sigma = 0.1$				$\sigma = 0.3$				$\sigma = 0.5$			
M	0	1	3	5	0	1	3	5	0	1	3	5
Panel A: c_s= 2, c_j= 8												
$L = 0.8$	62.98	59.02	59.02	59.02	47.10	75.76	75.76	75.76	46.78	82.70	82.70	82.70
$L = 1$	63.03	74.17	74.17	74.17	36.21	72.87	72.87	72.87	47.71	69.77	69.77	69.77
$L = 1.25$	35.86	64.07	57.63	57.53	30.09	68.90	61.53	57.75	52.01	67.58	61.83	57.05
Panel B: c_s= 5, c_j= 5												
$L = 0.8$	64.03	77.57	77.57	77.57	52.60	88.31	88.31	88.31	69.68	92.24	92.24	92.24
$L = 1$	60.98	99.48	99.48	99.48	60.32	97.38	97.38	97.38	75.86	94.69	94.69	94.69
$L = 1.25$	51.28	99.80	99.98	100	74.17	98.06	98.86	98.65	82.08	94.30	91.55	87.06
Panel C: c_s= 8, c_j= 2												
$L = 0.8$	61.20	70.35	70.35	70.35	43.95	84.21	84.21	84.21	57.24	91.57	91.57	91.57
$L = 1$	37.80	89.53	89.53	89.53	48.75	91.17	91.17	91.17	65.27	94.70	94.70	94.70
$L = 1.25$	11.32	94.06	98.12	99.52	58.42	94.51	96.69	96.69	72.95	96.24	96.33	96.33

Table A.6: APR violation frequency (all types) under current and reformed Chapter 11. This table reports the frequency of all types of APR violation (in percentage points). Various levels of operational risk (σ), leverage (L), and debt priority structure (c_s, c_j) are considered. Parameter M represents the maturity of the redemption option granted to junior creditors under the proposed Chapter 11 reform. The case $M = 0$ represents the current bankruptcy procedure.

APR Violation Frequency: All Types												
	$\sigma = 0.1$				$\sigma = 0.3$				$\sigma = 0.5$			
M	0	1	3	5	0	1	3	5	0	1	3	5
Panel A: c_s= 2, c_j= 8												
$L = 0.8$	89.77	59.02	59.02	59.02	91.70	75.76	75.76	75.76	94.33	82.70	82.70	82.70
$L = 1$	92.06	74.17	74.17	74.17	94.22	72.87	72.87	72.87	95.74	69.77	69.77	69.77
$L = 1.25$	95.83	100	100	100	96.78	100	100	100	96.86	100	100	100
Panel B: c_s= 5, c_j= 5												
$L = 0.8$	89.64	77.57	77.57	77.57	94.50	88.31	88.31	88.31	95.54	92.24	92.24	92.24
$L = 1$	92.12	99.48	99.48	99.48	97.08	97.38	97.38	97.38	96.92	94.69	94.69	94.69
$L = 1.25$	93.70	100	100	100	98.82	100	100	100	97.83	100	100	87.06
Panel C: c_s= 8, c_j= 2												
$L = 0.8$	92.32	70.35	70.35	70.35	92.65	84.21	84.21	84.21	94.94	91.57	91.57	91.57
$L = 1$	93.62	89.53	89.53	89.53	93.96	91.17	91.17	91.17	95.83	94.70	94.70	94.70
$L = 1.25$	93.97	100	100	100	95.72	100	96.69	96.69	96.61	100	96.33	96.33

Table A.7: Liquidation probability under current and reformed Chapter 11. This table reports the probability of liquidation. Various levels of operational risk (σ), leverage (L), and debt priority structure (c_s, c_j) are considered. Parameter M represents the maturity of the redemption option granted to junior creditors under the proposed Chapter 11 reform. The case $M = 0$ represents the current bankruptcy procedure.

Liquidation probability												
	$\sigma = 0.1$				$\sigma = 0.3$				$\sigma = 0.5$			
M	0	1	3	5	0	1	3	5	0	1	3	5
Panel A: c_s= 2, c_j= 8												
$L = 0.8$	5.58	0.04	0.04	0.04	4.89	0.87	0.87	0.87	4.39	4.66	4.66	4.66
$L = 1$	7.19	25.83	25.83	25.83	3.79	27.02	27.02	27.02	3.36	29.55	29.55	29.55
$L = 1.25$	4.13	35.93	42.37	42.48	2.28	31.05	38.46	42.25	2.57	31.95	38.09	43.38
Panel B: c_s= 5, c_j= 5												
$L = 0.8$	4.60	3.12	3.12	3.12	2.20	2.28	2.28	2.28	2.79	2.29	2.29	2.29
$L = 1$	6.65	0.09	0.09	0.09	1.27	0.56	0.56	0.56	1.99	3.30	3.30	3.30
$L = 1.25$	6.22	0.04	0.00	0.00	0.55	0.47	0.52	1.13	1.53	4.27	7.85	12.69
Panel C: c_s= 8, c_j= 2												
$L = 0.8$	5.01	4.87	4.87	4.87	5.37	4.08	4.08	4.08	4.31	2.39	2.39	2.39
$L = 1$	6.04	4.51	4.51	4.51	4.88	2.57	2.57	2.57	3.62	1.78	1.78	1.78
$L = 1.25$	6.02	3.67	2.15	1.01	3.70	1.71	1.09	1.09	3.02	1.89	2.01	2.01

References

[1] Adler, B. E., Capkun, V., & Weiss, L. A. (2013). Value destruction in the new era of Chapter 11. The Journal of Law, Economics, and Organization, 29(2), 461–483.

[2] Aghion, P., Hart, O., & Moore, J. (1992). The economics of bankruptcy reform. Journal of Law, Economics & Organization 8(3), 523–546.

[3] American Bankruptcy Institute (2014). ABI Commission to Study the Reform of Chapter 11, Alexandria: American Bankruptcy Institute.

[4] Annabi, A., Breton, M., & François, P. (2012). Resolution of financial distress under Chapter 11. Journal of Economic Dynamics and Control, 36(12), 1867–1887.

[5] Bebchuk, L. A. (2002). Ex ante costs of violating absolute priority in bankruptcy. The Journal of Finance, 57(1), 445–460.

[6] Betker, B. L. (1995). Management's incentives, equity's bargaining power, and deviations from absolute priority in Chapter 11 bankruptcies. Journal of Business, 161–183.

[7] Bris, A., Welch, I., & Zhu, N. (2006). The costs of bankruptcy: Chapter 7 liquidation versus Chapter 11 reorganization. The journal of finance, 61(3), 1253–1303.

[8] Bharath, S., Panchapagesan, V., & Werner, I. (2014). The Changing Nature of Chapter 11. IIM Bangalore Research Paper No. 46.

[9] Broadie, M., Chernov, M., & Sundaresan, S. (2007). Optimal debt and equity values in the presence of Chapter 7 and Chapter 11. The journal of Finance, 62(3), 1341–1377.

[10] Capkun, V., & Weiss, L. A. (2016). Bankruptcy Resolution and the Restoration of Priority of Claims. Working Paper, HEC Paris.

[11] Carapeto, M. (2006). Explaining deviations from absolute priority rules in bankruptcy. Journal of Empirical Legal Studies, 3(3), 543–560.

[12] Carapeto, M. (2007). An examination of multiple plans in Chapter 11 reorganizations. Journal of Financial Stability, 3(3), 279–293.

[13] Chang, T., & Schoar, A. (2006). Judge Specific Differences in Chapter 11 and Firm Outcomes. Working Paper, MIT Sloan School of Management, NBER and CEPR.

[14] Davydenko, S. A. (2012). When Do Firms Default? A Study of the Default Boundary. Working Paper, University of Toronto.

[15] Davydenko, S. A., Strebulaev, I. A., & Zhao, X. (2012). A market-based study of the cost of default. The Review of Financial Studies, 25(10), 2959–2999.

[16] François, P., & Morellec, E. (2004). Capital structure and asset prices: Some effects of bankruptcy procedures. The Journal of Business, 77(2), 387–411.

[17] Franks, J. R., & Torous, W. N. (1989). An empirical investigation of US firms in reorganization. The Journal of Finance, 44(3), 747–769..

[18] Galai, D., Raviv, A., & Wiener, Z. (2007). Liquidation triggers and the valuation of equity and debt. Journal of Banking & Finance, 31(12), 3604–3620.

[19] Graham, J. R., & Mills, L. F. (2008). Using tax return data to simulate corporate marginal tax rates. Journal of Accounting and Economics, 46(2-3), 366-388.

[20] Jiang, W., Li, K., & Wang, W. (2012). Hedge funds and Chapter 11. The Journal of Finance, 67(2), 513–560.

[21] Kahle, K. M., & Stulz, R. M. (2017). Is the US public corporation in trouble?. Journal of Economic Perspectives, 31(3), 67–88.

[22] Kalay, A., Singhal, R., & Tashjian, E. (2007). Is chapter 11 costly?. Journal of Financial Economics, 84(3), 772–796.

[23] Leland, H. E. (1994). Corporate debt value, bond covenants, and optimal capital structure. The journal of Finance, 49(4), 1213–1252.

[24] Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. The Journal of finance, 29(2), 449–470.

[25] PIMCO (2015). Proposed changed to U.S. bankruptcy code could create opportunities in distressed credit, Viewpoint, Newport Beach, CA: PIMCO.

[26] Shleifer, A., & Vishny, R. W. (1992). Liquidation values and debt capacity: A market equilibrium approach. The Journal of Finance, 47(4), 1343–1366.

[27] Tashjian, E., Lease, R. C., & McConnell, J. J. (1996). An empirical analysis of prepackaged bankruptcies. Journal of Financial Economics, 40(1), 135–162.

[28] Teloni, F. (2015). Chapter 11 Duration, Pre-Planned Cases, and Refiling Rates: An Empirical Analysis in the Post BAPCPA Era. American Bankruptcy Institute Law Review, 23, 571.

[29] Warren, E., & Westbrook, J. L. (2008). The success of Chapter 11: a challenge to the critics. Michigan Law Review, 107, 603–641.

[30] Weiss, L. A. (1990). Bankruptcy resolution: Direct costs and violation of priority of claims. Journal of Financial Economics, 27(2), 285–314.

[31] Wessels, B., & de Weijs, R. (2015). Proposed recommendations for the reform of chapter 11 US Bankruptcy Code. Ondernemingsrecht, 2015(37).