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CORPORATE BANKRUPCTY AS A FILTERING DEVICE

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Abstract

Chapter 11, the U.S. procedure for rehabilitating failing firms, has come under attack recently from several sides. Critics claim that its high costs drain troubled firms of resources, that it saves some firms that ought to shut down, and that it fails to save many of the firms that attempt to use it. In this paper, I present a model of why things go wrong in Chapter 11. The model assumes that there are two types of failing firms: those that are in financial distress but are nonetheless economically efficient and those that are economically inefficient. From an economic efficiency standpoint, the goal of a corporate bankruptcy procedure is to shut down inefficient firms while saving efficient firms, i.e., to filter out inefficient firms. In the U.S., Chapter 7 is designed to do the former by liquidating failing firms in bankruptcy, while Chapter 11 is designed to do the latter by allowing failing firms to reorganize in bankruptcy. However, it is difficult to identify which failing firms are efficient and which are inefficient. As a result, the bankruptcy procedure operates with error: type I error occurs if economically inefficient firms are saved in Chapter 11, while type II error occurs if economically efficient firms shut down in Chapter 7. The basic bankruptcy dilemma is that - given imperfect information - it is impossible to save all economically efficient failing firms while at the same time shutting down all inefficient failing firms.

The paper presents a game theoretic model of the bankruptcy process which explores the filtering properties of the Chapter 7/Chapter 11 combination. Perfect filtering occurs if all efficient firms file under Chapter 11 and all inefficient firms file under Chapter 7. Filtering failure occurs if both economically efficient and economically inefficient firms file for bankruptcy under Chapter 11, i.e., a pooling equilibrium occurs. Pooling may occur both because efficient firms benefit from appearing to be less efficient than they actually are *and* because inefficient firms benefit from appearing to be more efficient than they actually are. Efficient firms benefit from appearing to be inefficient since this makes creditors more likely to accept reorganization plans that provide low payoffs; while inefficient firms benefit from appearing to be efficient since creditors are then more likely to accept a reorganization plan in the first place. A simulation of the pooling equilibrium using data from empirical studies of corporate bankruptcy suggests that it is likely to occur in practice.

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Corporate Bankruptcy as a Filtering Device

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Nearly all firms that exit the market do so via bankruptcy.[1] From an economic efficiency standpoint, the goal of a corporate bankruptcy procedure is to shut down firms that are economically inefficient while leaving in operation firms that are economically efficient, *i.e.*, to filter out inefficient firms. However, filtering procedures are subject to error. In the bankruptcy context, type I error occurs if economically inefficient firms continue to operate, while type II error occurs if economically efficient firms shut down.

Corporate bankruptcy law in the U.S. consists of two separate procedures: Chapter 7 involves liquidation of failing firms in bankruptcy, while Chapter 11 is designed to save failing firms by encouraging them to reorganize in bankruptcy. In this paper I explore how well both Chapter 7 by itself and the Chapter 7/Chapter 11 combination perform the bankruptcy filtering function. I show that Chapter 7 alone tends to minimize type I error, but to cause high levels of type II error; while the combination of Chapters 7 and 11 reduces type II error at the expense of increased type I error. From a policy standpoint, the basic bankruptcy dilemma is that it is impossible to save all economically efficient failing firms while shutting down all inefficient failing firms, because outsiders do not know with certainty which firms are of each type. Therefore any policy designed to shut down inefficient failing firms will also shut down some efficient but failing firms. And any policy designed to save efficient but failing firms will also save some inefficient failing firms.[2]

In the paper I present a game theoretic model of the bankruptcy process which explores the filtering properties of the Chapter 7/Chapter 11 combination. Managers of failing firms decide whether to file under Chapter 7 or Chapter 11 and, if they file under Chapter 11, they choose between proposing reorganization plans which involve high or low payoffs to creditors. Managers are assumed to know whether their firms are efficient or inefficient at the time they file for bankruptcy, but creditors do not. Managers of economically efficient firms always file under Chapter 11, but they choose between proposing high or low payoff reorganization plans. Managers of economically inefficient firms choose between filing under Chapter 7 or filing under Chapter 11 and offering low payoff reorganization plans. Creditors always accept high payoff plans, but may either accept or reject low payoff plans. Filtering failure occurs if the game results in a pooling equilibrium in which both economically efficient and inefficient firms file for bankruptcy under Chapter 11. Pooling may occur since efficient firms benefit from appearing to be less efficient than they are—

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[1] The main exceptions are subsidiaries of conglomerate firms. Parent firms normally shut down unprofitable subsidiaries without filing for bankruptcy and without losses to creditors, because the parent has guaranteed the subsidiary's debt.

[2] Bulow and Shoven (1978) first pointed out that managers may have an incentive to make economically inefficient bankruptcy decisions. Their model was concerned only with Chapter 7, however, and it assumed perfect information. For discussion and a survey of more recent literature in the area, see White (1989).

this makes creditors more likely to accept low payoff reorganization plans; while inefficient firms benefit from appearing to be more efficient than they are—this makes creditors are more likely to accept a reorganization plan in the first place.

Section 1 of the paper examines the filtering properties of bankruptcy when the only bankruptcy procedure is liquidation under Chapter 7. Section 2 introduces bankruptcy reorganization under Chapter 11 and develops the model of the interaction between the two procedures. In section 3, a simulation model is presented which explores how likely it is that filtering failure actually occurs. Section 4 explores public policy implications of type I verses type II error in bankruptcy and concludes.

1. Type I and Type II Error under Chapter 7

Suppose whenever a firm enters bankruptcy, it is liquidated under Chapter 7. This means that the firm is shut down, the bankruptcy judge appoints a trustee who displaces managers, the trustee locates and sells whatever assets of the firm can be found, and the proceeds are paid to creditors according to the absolute priority rule. The latter calls for the administrative expenses of bankruptcy to paid first, priority expenses such as unpaid wages and taxes to be paid second, unsecured creditors to be paid third, and equity to receive the remainder, if any. Creditors receive payment in full until funds are exhausted. Secured creditors, who are outside the priority ordering, can reclaim the assets on which they hold liens.

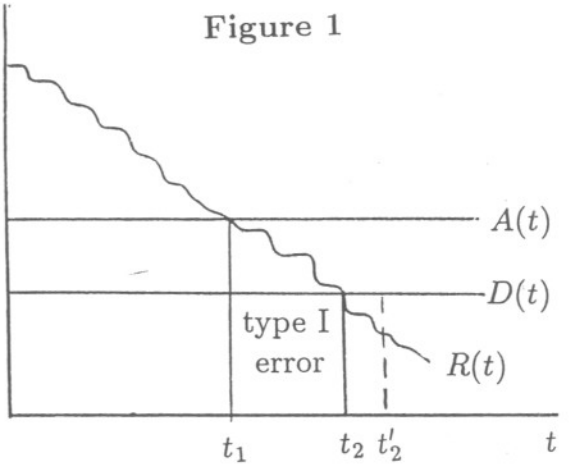
Declining earnings firms

Figure 1 illustrates the situation of a firm whose revenues are declining over time, perhaps because its technology is becoming outmoded or its product is going out of style. Revenues at time t are $R(t)$. They are defined here as being net of expenses such as wages and materials costs that must be paid immediately in order for the firm to continue operating, but before payments on short-term or long-term debt are made and before such expenses as taxes and insurance.[3] Alternate net revenues $A(t)$ represent what the firm's revenues would be, net of the cost of investment, if its capital were used in the most profitable way. For example, suppose the firm is a chain of Mexican restaurants, when the latest restaurant fad is Louisiana cuisine. $A(t)$ then represents the firm's revenues as a restaurant chain with a Louisiana theme, net of the cost of conversion. At time t_1, it becomes economically efficient either for the firm to convert to the higher value use or to shut down and be liquidated, in which case its assets will be sold and the new owners will undertake the investment.

Since the investment is profitable, in general we expect the firm's existing managers to undertake it. However, in some cases managers will not invest, perhaps because their specific capital is unsuited to operating the firm in its new use (the restaurants' current managers may be Mexican food specialists) or because managers are unable to borrow funds to finance the conversion. Lenders may be unwilling to lend since their claims would

[3] Strictly speaking, the firm's liability to pay expenses such as wages and materials costs is similar to its liability to pay any other debt due in the current period, except that non-payment of wages (and payroll taxes) carries criminal penalties while non-payment of other liabilities does not.

Figure 1



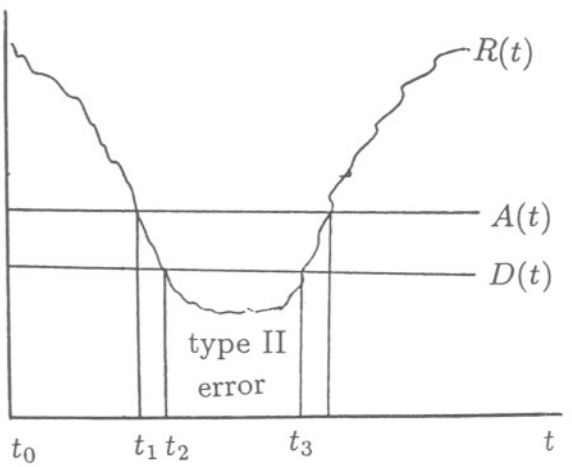


Figure 2

rank behind those of existing creditors, making the loan very risky.[4] If managers do not invest, then the firm will eventually shut down. Exactly when it shuts down depends on its expenses $D(t)$. Expenses due in period t include liabilities to pay interest and principle on long or short-term debt due at time t and any other current expenses not already subtracted from $R(t)$. For simplicity, expenses are assumed to be constant over time. As shown in figure 1, the firm begins to make losses at time t_2 and its losses increase thereafter. The firm shuts down and files for bankruptcy at time t_2', at which point its assets are sold and its new owners undertake the investment. Between t_1 and the time the firm shuts down, type I error occurs since an economically inefficient firm continues to operate. Type I error occurs because managers pass up economically worthwhile investment opportunities. Bankruptcy thus provides a check on the amount of type I error that occurs when inefficient firms continue to operate.

Since the time interval between t_1 and the firm's bankruptcy filing at t_2' may be prolonged, the question of when failing firms file for bankruptcy is an important public policy issue. Bankruptcy law in the U.S. discourages creditors of failing firms from initiating involuntary bankruptcies, so that most bankruptcy filings are made voluntarily by managers.[5] If the only form of bankruptcy is liquidation, managers of failing firms have an incentive to delay filing as long as possible, both because they lose their jobs and because equity loses its value when the bankruptcy filing occurs. A common way for managers to delay filing for bankruptcy after the firm begins making losses is to use the firm's assets to pay current expenses. Creditors whose loans come due are given a security interest in some free asset of the firm in return for renewing their loans or extending new ones. This makes creditors willing to lend to the firm even though it is failing, since the security interest makes their loans less risky. By giving creditors security interests, managers can often delay filing for bankruptcy until all the firm's assets are subject to secured creditors' liens.[6] In addition, managers can simply not pay the claims of unsecured creditors, since these creditors must sue the firm for repayment and such suits are time-consuming.[7] In general, managers' ability to delay filing for bankruptcy depends on how vigilant creditors are in monitoring the firm and how quickly they sue the firm when it begins to fail. Managers of small firms are likely to be able to delay longer than managers of large firms, since creditors of small firms are less likely to have enough at stake to justify careful monitoring.[8]

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[4] If new loans are used to buy new equipment, then lenders can take a security interest in the equipment, which reduces the riskiness of the loan. But in the example of the restaurant conversion, new funds would be used for redecoration of the restaurants and a consultant to develop a new menu, but these assets do not provide valuable security to a lender.

[5] In 1981, only 170 of 7,310 Chapter 11 bankruptcy filings were involuntary, or .2%. See Administrative Office of the U.S. Courts, *Federal Judicial Workload Statistics, 1981*, tables F2A and F2B.

[6] See Schwartz (1981) for discussion. In a large sample of firms filing for bankruptcy under Chapter 7, Ames *et al* (1983) found that the average ratio of secured liabilities to total assets was around 1 and the average ratio of total liabilities to total assets was over 7 at the time of the bankruptcy filing.

[7] In contrast, managers must pay the claims of secured creditors if they wish to keep the assets on which creditors have liens, since creditors can reclaim their assets without a court hearing if the firm defaults.

[8] See Gertner and Scharfstein (1990) for a model which explores lenders' incentives to lend to failing firms.

As long as alternate net revenues $A(t)$ exceed expenses, then the lower is $D(t)$, the longer the period of type I error. Since debt obligations are a major component of $D(t)$, the lower the firm's debt level, the longer it can delay filing for bankruptcy and therefore the more type I error occurs. High debt has the opposite effect. Thus when firms take on debt, they become more vulnerable to the discipline of bankruptcy, since the firm will be forced to shut down more quickly if it is inefficient. Use of outside finance thus has a social value (in addition to its value to the firm), since increased outside borrowing raises $D(t)$ and therefore reduces type I bankruptcy error. Further, there is an economically efficient level of debt which minimizes type I error. If the firm's expenses per period equaled its alternate net revenues per period, or $D(t) = A(t)$, then firms would tend to file for bankruptcy at approximately the time they become economically inefficient, although some type I error would still be likely to occur since managers can delay filing for bankruptcy after the firm begins making losses. The level of debt $D(t) = A(t)$ is optimal since it forces managers to take account of the social opportunity cost of tying up capital in the firm's operations, since the social opportunity cost of capital equals the firm's actual expenses.

Figure 1 thus illustrates how declining earnings firms cause type I bankruptcy error because managers delay the firm's shutdown longer than is economically efficient. Note that while figure 1 assumes that the firm's revenues are declining and its expenses are constant over time, the implications would remain the same if instead the firm's revenues were constant over time and its expenses were increasing. Again type I error would occur since the firm would shut down later than is economically efficient.

Fluctuating earnings firms

Figure 2 shows another type of failing firm—referred to as a fluctuating earnings firm. Its revenues $R(t)$ fluctuate over time, perhaps because they are sensitive to the business cycle or because the firm is developing a new product which it has not yet brought to market. Suppose $PV(R)$ and $PV(A)$ denote the present value of the firm's future revenues and the present value of its future alternate net revenues, respectively, over the entire business cycle. As shown in figure 2, $PV(R) > PV(A)$, so that the firm is economically efficient. However, given its debt level $D(t)$, the firm makes losses at the bottom of the business cycle, from time t_2 to t_3. These losses may cause the firm to shut down and file for bankruptcy even though it is economically efficient. Whether the firm files for bankruptcy depends on whether it has sufficient free assets to cover its losses until it becomes profitable again, or can raise additional funds by borrowing or issuing equity, or can merely not pay its unsecured debts in hopes that by the time creditors succeed in collection actions against it, it will be profitable again. If the firm files for bankruptcy, then type II error occurs, since it is economically efficient and should continue to operate. The period during which type II error is possible depends on the level of the firm's debt.

Unlike the situation in figure 1, lower debt in figure 2 reduces bankruptcy error, since it makes the region of possible type II error smaller. Thus for economically efficient firms, outside debt has a social cost since the higher is $D(t)$, the more type II bankruptcy error occurs. Nonetheless, a debt level of $D(t) = A(t)$ would again tend to produce economically efficient results. While firms having this debt level would make losses at the bottom of the business cycle, they are unlikely to go bankrupt since the present value of their revenues

exceeds the present value of expenses over the cycle, or $PV(R) > PV(D) = PV(A)$.[9]

Figures 1 and 2 thus illustrate two basic types of failing firms: those with declining earnings that should shut down and those with fluctuating earnings that should be saved. Declining earnings firms have both falling revenues and revenues whose present value is less than their present value in some alternate use, or $PV(R) < PV(A)$. These firms give rise to type I bankruptcy error since they tend to continue operating past the point where it is economically efficient for them to shut down. Fluctuating earnings firms have $PV(R) > PV(A)$ and they give rise to type II bankruptcy error since they sometimes shut down even though it is economically efficient for them to be saved. However, the assumption that type I error is associated only with declining earnings firms and type II error is associated only with fluctuating earnings firms is sometimes violated. For example, suppose the $A(t)$ and $D(t)$ curves in figure 1 were reversed. Then the firm would begin to make losses and could go bankrupt as early as t_1, but should go bankrupt only at t_2. Thus, type II error could occur from time t_1 to t_2. However, this situation seems unlikely to occur given managers' ability to delay filing for bankruptcy.[10] Similarly, fluctuating earnings firms might be associated with type I error if they could shut down temporarily at the bottom of their cycle and reopen later, but do not. Since the transactions costs of shutting down and reopening are high, this seems unlikely. These types of error are both ignored in the analysis below.[11]

As of time t_2 in figures 1 and 2, both fluctuating and declining earnings firms have falling revenues and both are beginning to make losses, so that they look essentially alike. The difference between them depends on revenues $R(t)$ in the future, which are unobservable, and on alternate net revenues $A(t)$, which are also unobservable. Thus there is likely to be genuine uncertainty concerning the firm's type. In the analysis below, I assume that managers know the firm's type, but creditors do not—at least initially. Since managers control the flow of information to creditors, they can pass on information that supports their position and hold back information that undermines their position, as long as they comply with formal disclosure rules. Further, a bankruptcy filing by the firm does little to clarify the situation as long as managers remain in control.

2. A Game Theoretic Model of Filtering in Chapter 11 Bankruptcy

In this section, I explore a model of the bankruptcy decision when Chapter 7 bankruptcy liquidation and Chapter 11 bankruptcy reorganization are both possible. Chapter 11 is the U.S. bankruptcy procedure intended to save failing firms. When managers of failing firms

[9] Note that increased earnings variability also has a social cost if transactions costs are high. Higher earnings variability increases fluctuating earnings firms' losses at the bottom of the business cycle and therefore increases the likelihood that these firms will go bankrupt at the bottom of the business cycle, causing type II error.

[10] This case corresponds to the situation frequently discussed in introductory economics textbooks in which a firm should shut down eventually since price is less than average total cost, but should continue to operate temporarily until its capital wears out, since price exceeds average variable cost. If the firm shuts down before its capital wears out (*i.e.*, before average variable cost rises to the point that it exceeds price), type II error occurs.

[11] Obviously, failing firms can also fall in-between the fluctuating and declining earnings cases.

file for bankruptcy, they have a choice between filing under Chapter 7 or Chapter 11. If they choose Chapter 11, then normally they remain in control of the firm.[12] Managers have the exclusive right for at least six months to propose a reorganization plan which settles the claims of all the firm's pre-bankruptcy creditors. Creditors must vote yes or no on managers' plan before they can propose their own and often the bankruptcy judge extends managers' exclusivity period until creditors accept some management plan, *i.e.*, creditors never have an opportunity to propose their own plans.[13] Firms filing under Chapter 11 receive subsidies from creditors and the government—these are discussed below.

The model is intended to explore under what conditions perfect filtering occurs in bankruptcy. Perfect filtering in bankruptcy is defined as a situation in which all declining earnings firms file for bankruptcy liquidation under Chapter 7 and all fluctuating earnings firms file for bankruptcy reorganization under Chapter 11. A bankruptcy system that leads to perfect filtering is economically efficient since all inefficient failing firms shut down under Chapter 7 and all efficient but failing firms at least have the opportunity to be saved under Chapter 11. Filtering failure in bankruptcy occurs when at least some declining earnings firms file for bankruptcy reorganization under Chapter 11, thereby wasting resources. The model is designed to capture the basic features of U.S. bankruptcy law.[14]

The model is illustrated in figure 3. On the right, managers of declining earnings firms choose between filing under Chapter 7 or filing under Chapter 11 and offering low payoff reorganization plans. On the left, managers of fluctuating earnings firms always file under Chapter 11, but choose between offering high or low payoff plans. Creditors must vote on reorganization plans without knowing whether the firm proposing the plan has declining or fluctuating earnings. If creditors reject a low payoff reorganization plan, then I assume that the firm's type is revealed, either because managers are displaced and the firm is liquidated or because the bankruptcy judge forces managers to reveal more information, perhaps by appointing a trustee.[15]

Managers of both types of firms are assumed to maximize the present value of the firm's "disposable revenues," which are revenues $R(t)$ including the value of the firm's free assets, minus payments made to creditors, plus the value of subsidies in reorganization, minus the costs of bankruptcy. Although managers are not assumed to act in the interest

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[12] In a sample of small firms filing under Chapter 11, LoPucki (1983) found that bankruptcy trustees were appointed in only 6%. This includes cases in which the manager had abandoned the business, so that the appointment of a trustee was unopposed. In a sample of large firms filing in Chapter 11, LoPucki and Whitford (1992) found that trustees were appointed in only 5% of cases.

[13] In a study of 43 large Chapter 11 cases, LoPucki and Whitford (1990) found that in all but 9, the exclusivity period was extended until creditors accepted a management plan. In Weiss' (1992) sample of 30 large firms that reorganized, only one involved adoption of a plan proposed by creditors.

[14] There are several other papers that use the assumption of imperfect information to explore aspects of the bankruptcy process, but most are focussed on other questions. See Giammarino (1989) who examines when firms may rationally choose to incur high bankruptcy costs, Bebchuk (1991) who examines the efficiency of investment incentives by managers when bankruptcy is a possibility, and Gertner and Picker (1992) who both examine investment incentives by managers and consider the efficiency implications of several alternative bankruptcy regimes.

[15] The model is a signaling game, since the informed parties (managers) act first and thereby convey information to the uninformed parties (creditors). See Kreps (1990), p. 651.

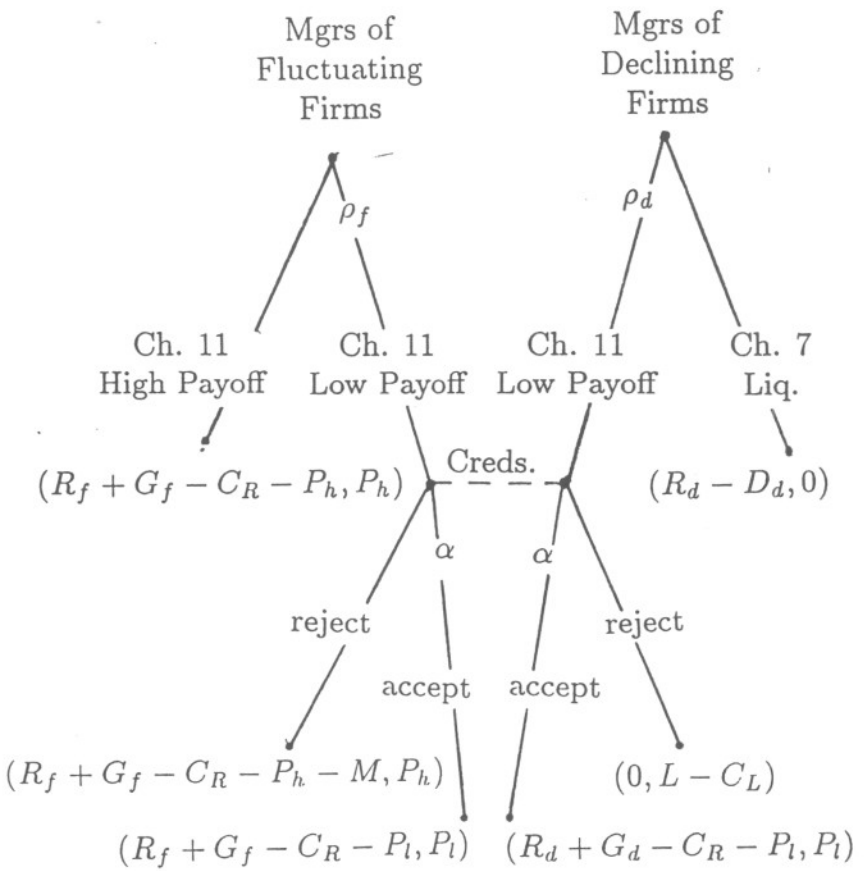
Mgrs of Fluctuating Firms
Mgrs of Declining Firms
ρ_f
ρ_d
Ch. 11 High Payoff
Ch. 11 Low Payoff
Ch. 11 Low Payoff
Ch. 7 Liq.
$(R_f + G_f - C_R - P_h, P_h)$
Creds.
$(R_d - D_d, 0)$
α
α
reject
accept
accept
reject
$(R_f + G_f - C_R - P_h - M, P_h)$
$(0, L - C_L)$
$(R_f + G_f - C_R - P_l, P_l)$
$(R_d + G_d - C_R - P_l, P_l)$

Figure 3

of equity in making the bankruptcy decision, their interests are still generally aligned with those of equity, since equityholders benefit when the firm is saved and managers wish to save the firm—and their own jobs—as long as possible.[16]

Managers of declining earnings firms

Examine the choice by managers of declining earnings firms first. If they choose to file for bankruptcy liquidation under Chapter 7, then they have an incentive to delay the firm's bankruptcy filing as long as possible but will be forced to file for bankruptcy at time t_2' in figure 1. The present value of the firm's future revenues from time t_1 to t_2' is the area under the $R(t)$ curve in figure 1 from t_1 to t_2' plus the value of the firm's free assets (since assets can be used to pay creditors). This amount is denoted R_d, where the subscript d indicates a declining earnings firm. D_d is the minimum amount that managers can pay creditors consistent with remaining out of bankruptcy from time t_1 to t_2'. D_d is less than the area under the $D(t)$ curve in figure 1 over the same period, since managers of failing firms do not pay all of the firm's liabilities in full. Thus the present value of the firm's disposable revenues from time t_1 until it shuts down is $R_d - D_d$. $R_d - D_d$ is assumed to measure managers' benefit from running a declining earnings firm when the choice has been made to avoid bankruptcy as long as possible and eventually to file under Chapter 7.

Alternately, managers of declining earnings firms can file for bankruptcy reorganization under Chapter 11. If they do so, the present value of the firm's future revenues is still assumed to be R_d, since the choice of bankruptcy process is a financial rather than a real decision. (By assumption, declining earnings firms will still shut down eventually even if they file under Chapter 11.) Managers may receive subsidies from the government whose present value is G_d—these are discussed below—and they must pay an immediate cost of reorganizing, C_R. C_R is the cost of hiring lawyers and other professionals to manage the firm's bankruptcy filing and to advise managers and creditors. Managers propose a reorganization plan which offers creditors a low payoff, denoted P_l. Thus if managers file under Chapter 11 and creditors accept managers' reorganization plan, then the firm's disposable revenues are $R_d + G_d - C_R - P_l$. This amount is assumed to be positive, so that the strategy of offering a low payoff plan under Chapter 11 is feasible. If, instead, creditors reject managers' proposed reorganization plan, then creditors are assumed to learn that the firm has declining earnings. The firm is then liquidated—either piecemeal or as a going concern. Creditors are assumed to receive the entire proceeds, so that managers get nothing.

Choosing to reorganize a declining earnings firm in bankruptcy is assumed to be a gamble for managers. If managers offer low payoff plans and creditors accept, then managers are better off than if they had filed under Chapter 7. However, if managers offer low payoff plans and creditors reject, then managers are worse off than if they had filed under Chapter 7. Thus $R_d + G_d - C_R - P_l > R_d - D_d > 0$.

Suppose ρ_d denotes the probability that managers of declining earnings firms choose to offer low payoff reorganization plans and α denotes the probability that creditors accept

[16] It might be argued that managers' interest in this situation is to leave the firm rather than remain. However, even if one set of managers leaves, then the new set of managers has an incentive to behave as hypothesized here.

these plans. Then managers of declining earnings firms choose ρ_d to maximize the expected value of the firm's disposable revenues, or:

$$\rho_d[\alpha(R_d + G_d - C_R - P_l)] + (1 - \rho_d)[R_d - D_d] \tag{1}$$

The derivative of (1) with respect to ρ_d is:

$$\alpha(R_d + G_d - C_R - P_l) - (R_d - D_d) \tag{2}$$

By the Kuhn-Tucker theorem, ρ_d equals 1 if (2) is positive, ρ_d equals 0 if (2) is negative, and ρ_d is between 0 and 1 if (2) equals zero. Suppose α^* is the value of α such that (2) equals zero, or:

$$\alpha^* = \frac{R_d - D_d}{R_d + G_d - C_R - P_l} \tag{3}$$

The best strategy of managers of declining earnings firms is always to offer low payoff reorganization plans under Chapter 11 ($\rho_d = 1$) if creditors' actual acceptance rate α exceeds α^*, always to liquidate under Chapter 7 ($\rho_d = 0$) if $\alpha < \alpha^*$, and to play mixed strategies ($0 < \rho_d < 1$) if $\alpha = \alpha^*$.

Managers of fluctuating earnings firms

Managers of fluctuating earnings firms choose between offering low payoff or high payoff reorganization plans under Chapter 11. In either case, filing for bankruptcy reorganization is assumed to save the firm. The present value of future revenues of fluctuating earnings firms, R_f, is assumed to equal the integral under $R(t)$ in figure 2 from time t_2 at least through the next business cycle. The immediate cost of filing to reorganize is still C_R. The present value of government subsidies to fluctuating earnings firms in reorganization is denoted G_f. G_f may exceed G_d since fluctuating earnings firms generally remain in operation longer and thus benefit more from the same set of subsidies. The present value of the firm's disposable revenues is $R_f + G_f - C_R - P_l$ under the low payoff reorganization plan and $R_f + G_f - C_R - P_h$ under the high payoff reorganization plan, where P_h is the present value of payments to creditors under the high payoff plan. Both high payoff and low payoff reorganization plans are assumed to be feasible for fluctuating earnings firms.[17]

If managers of fluctuating earnings firms offer low payoff reorganization plans and creditors reject, then creditors again learn the firm's type. Creditors then propose a high payoff reorganization plan, which is accepted by all parties. Creditors receive P_h under the second reorganization plan, but the plan is assumed to cost the firm $P_h + M$. M can either be interpreted as extra transactions costs which the firm must pay or as the cost to managers of extra supervision by creditors or a bankruptcy trustee after managers' plan is rejected. Thus managers gamble when they offer low payoff reorganization plans: if creditors accept, then managers are better off than if they had offered a high payoff

[17] While P_l and P_h are treated here as lump sum payments, in actuality payoffs to creditors under reorganization plans are typically made over several years. Future payoffs under reorganization plans are obviously risky, since firms—particularly declining earnings firms—may not survive long enough to complete the promised schedule of payments.

plan, but if creditors reject, then managers are worse off. Thus $R_f + G_f - C_R - P_l > R_f + G_f - C_R - P_h > R_f + G_f - C_R - P_h - M$.

Suppose ρ_f is the probability that managers of fluctuating earnings firms offer low payoff reorganization plans. Managers choose ρ_f to maximize:

$$\begin{aligned}\rho_f[\alpha(R_f + G_f - C_R - P_l) + (1-\alpha)(R_f + G_f - C_R - P_h - M)] \\ + (1-\rho_f)[R_f + G_f - C_R - P_h]\end{aligned} \tag{4}$$

The derivative of (4) with respect to ρ_f is:

$$[\alpha(R_f + G_f - C_R - P_l) + (1-\alpha)(R_f + G_f - C_R - P_h - M)] - (R_f + G_f - C_R - P_h) \tag{5}$$

By the Kuhn-Tucker theorem, $\rho_f = 1$ if (5) is positive, $\rho_f = 0$ if (5) is negative, and $0 < \rho_f < 1$ if (5) equals zero. Suppose α^{**} is the value of α such that (5) equals zero, or:

$$\alpha^{**} = \frac{M}{P_h + M - P_l} \tag{6}$$

The best strategy of managers of fluctuating earnings firms is to offer only low payoff reorganization plans if creditors' actual acceptance rate α exceeds α^{**}, to offer only high payoff plans if creditors' actual acceptance rate α is less than α^{**}, and to play mixed strategies ($0 < \rho_f < 1$) if $\alpha = \alpha^{**}$.

Creditors

Now consider creditors. Their only choice is whether to accept or reject low payoff reorganization plans. They must make this decision without knowing the firm's type. If they accept low payoff plans, they receive P_l with certainty. If they reject, then they learn the firm's type. If it has fluctuating earnings, creditors receive P_h. If it has declining earnings, the firm is liquidated and creditors receive $L - C_L$, where L is the liquidation value of the firm's assets, C_L is the cost of liquidation, and $L > C_L$.[18] Rejecting a low payoff plan is assumed to be a gamble for creditors: they are better off if the firm has fluctuating earnings but worse off if it has declining earnings. Thus $P_h > P_l > L - C_L$.[19]

Suppose γ' is the probability that a firm has fluctuating earnings conditional on its offering a low payoff reorganization plan. Creditors' expected return from low payoff plans is:

$$\alpha[P_l] + (1-\alpha)[\gamma'(P_h) + (1-\gamma')(L - C_L)] \tag{7}$$

[18] C_L can be interpreted either as the transactions costs of liquidating the firm's assets, including the share that goes to the bankruptcy trustee, or as the difference between what the firm's assets are worth and what they bring in a bankruptcy auction. See Easterbrook (1991) for an argument that bankruptcy auctions are inefficient.

[19] Note that creditors are assumed to receive more when they reject a reorganization plan proposed by a declining earnings firm and it subsequently liquidates than when a declining earnings firm files voluntarily under Chapter 7. In the former case, creditors receive $L - C_L$, while in the latter they receive zero. This is because managers intending to file under Chapter 7 delay filing as long as possible and during the delay period, they use up the firm's assets.

Since managers know whether their firms have fluctuating or declining earnings, creditors gain information from whether managers choose to offer low payoff plans. Suppose γ is the unconditional probability of a failing firm having fluctuating earnings. Creditors use Bayes' Law to learn about γ:[20]

$$\gamma' = \frac{\rho_f \gamma}{\rho_f \gamma + \rho_d (1 - \gamma)} \tag{8}$$

Creditors maximize their expected return from low payoff reorganization plans over their choice of α. Substituting (8) into (7) and taking the derivative with respect to α, we get:

$$P_l - \frac{\rho_f \gamma P_h + \rho_d (1 - \gamma)(L - C_L)}{\rho_f \gamma + \rho_d (1 - \gamma)} \tag{9}$$

Creditors' best strategy is always to accept low payoff reorganization plans ($\alpha = 1$) if (9) is positive, always to reject low payoff plans ($\alpha = 0$) if (9) is negative, and to play mixed strategies ($0 < \alpha < 1$) if (9) equals zero.

Subsidies to firms in Chapter 11

Before turning to the results of the model, consider the subsidies that firms receive when they file to reorganize under Chapter 11 rather than to liquidate under Chapter 7. There are two potential sources of subsidies: the government and the firm's own creditors. Subsidies from the government, denoted G_d or G_f, include tax subsidies and the possibility of transferring the firm's pension plan to the government. The most important tax subsidy is the right of firms in Chapter 11 to retain their net operating loss carryforwards, which would be lost if they filed under Chapter 7. Net operating loss carryforwards have allowed some bankrupt firms to emerge from Chapter 11 as attractive merger partners, since they can use their loss carryforwards to shelter the profits of their merger partners from tax.[21] Some firms in Chapter 11 are also able to transfer responsibility for their pension plans to the Pension Benefit Guaranty Corporation, a public agency, which in effect subsidizes the firm by paying its unfunded pension liabilities. Note that if a failing firm liquidated under Chapter 7 rather than reorganizing under Chapter 11, its workers might still receive the P.B.G.C. subsidy. But the benefit to managers from the subsidy would then be zero.[22]

The other source of subsidies to firms in reorganization is firms' own creditors, including its suppliers, workers and customers. Since managers of declining earnings firms have a choice between filing under Chapter 7 or 11, the subsidy to firms in reorganization is the difference between what a firm must pay its creditors if it remains out of bankruptcy as

[20] See Salant and Rest (1982).

[21] There are also carryforwards for unused foreign tax credits and investment tax credits. Since the Tax Reform Act of 1986, in order for firms to retain their NOL carryforwards in Chapter 11, old equityholders and creditors who have held claims against the firm for at least 18 months must own at least 50% of the equity in the post-reorganization firm. See Franks and Torous (1991) for discussion.

[22] The P.B.G.C. guarantees over 100,000 pension plans covering 40 million workers. The industries with the largest underfunded pension liabilities are airlines, steel, automobiles, and tires. See S. Clark, "Hanging Tough at the P.B.G.C.," *Institutional Investor*, vol. 24, p. 97, Sept. 1990.

long as possible and finally files under Chapter 7 versus what it must pay if it files under Chapter 11. For a declining earnings firm, this difference is $D_d - P_l$. If this amount is positive, then there is a net subsidy to declining earnings firms in reorganization.

This subsidy has several components. The most important is managers' option to delay payment in Chapter 11. Firms in Chapter 11 stop paying interest to creditors from the time they file for bankruptcy until a reorganization plan is approved and put into effect.[23] Since managers typically remain in control during the reorganization process and can delay the adoption of a plan, the real value of P_l falls relative to that of D_d, since P_l is paid later than D_d.[24] Another subsidy to firms in Chapter 11 is managers' right to cancel any contracts with suppliers or customers that are unprofitable. (Losses due to canceled contracts become unsecured claims against the firm.) In contrast, all contracts are canceled in Chapter 7, regardless of whether they are profitable or not. Firms in Chapter 11 can also modify their collective bargaining agreements to cut previously agreed-on wages, subject to the approval of the bankruptcy judge.[25] Firms can also use Chapter 11 to avoid paying tort claimants and environmental cleanup costs. Finally, some creditor groups are entitled to less in Chapter 11 than in Chapter 7. In particular, secured creditors have the right to reclaim their lien assets without a court hearing outside of bankruptcy, but are subject to the "automatic stay" once the firm files under Chapter 11. The payments they receive in Chapter 11 are often inadequate to compensate them for the firm's continued use of their lien assets. These redistributions reduce the total amount paid to creditors in Chapter 11 relative to what they would receive if the firm remained out of bankruptcy longer and finally filed under Chapter 7.

From the condition for managers of declining earnings firms to face a gamble in choosing Chapter 11, it must be the case that $R_d + G_d - C_R - P_l > R_d - D_d > 0$ or that

$$G_d + (D_d - P_l) > C_R \tag{10}$$

Thus for managers of declining earnings firms to choose to file under Chapter 11, the total value of subsidies in reorganization from the government G_d and the firm's creditors $(D_d - P_l)$ must exceed the cost of reorganizing. For some firms, the subsidy from the government may equal zero, so that (10) becomes $D_d - P_l > C_R$. For other firms, the subsidy from the government is positive so that reorganization may be attractive even if the subsidy from creditors in Chapter 11 is zero or even negative.

[23] The only exception is that they must pay interest to "over-secured creditors" who have liens on assets having market value greater than the face value of their claims.

[24] Firms such as LTV and Manville have remained in Chapter 11 for up to 6 years.

[25] The best known example of use of Chapter 11 to change collective bargaining agreements is Continental Airlines. Subsequently, Congress amended the Bankruptcy Code to make doing so more difficult, but it is still possible. LTV recently requested permission from the bankruptcy court to modify its collective bargaining agreement.

Results

There are nine possible strategy combinations for managers of fluctuating and declining earnings firms. See table 1. Managers of fluctuating earnings firms can offer low or high payoff reorganization plans exclusively or can play mixed strategies; while managers of declining earnings firms can offer low payoff plans exclusively, file for bankruptcy liquidation exclusively, or play mixed strategies. For each strategy combination, creditors have an acceptance rate α for low payoff plans which is their best response. Examine possibility 1 first. Here, managers of fluctuating earnings firms only offer high payoff reorganization plans and managers of declining earnings firms only liquidate, or $\rho_d = \rho_f = 0$. Suppose creditors never accept low payoff plans, or $\alpha = 0$.[26] This combination of strategies is a Nash equilibrium since if creditors never accept low payoff reorganization plans, the best response of managers of both types of firms is never to offer them. And if managers never offer low payoff plans, then creditors never accept them. Possibility 1 therefore leads to perfect filtering in bankruptcy and is economically efficient. Substituting $\rho_p = \rho_f = \alpha = 0$ into (2), (5) and (9), the conditions for the perfect filtering (PF) equilibrium 1 can be derived and are given in the left column of table 2.

There are two other possibilities that also involve perfect filtering, labelled 2 and 3 in table 1. In both, all declining earnings firms liquidate in bankruptcy ($\rho_d = 0$), but fluctuating earnings firms may either offer only low payoff plans or play mixed strategies. However, neither possibility is an equilibrium. In both, creditors learn that all low payoff reorganization plans are offered by fluctuating earnings firms. Therefore creditors' best response is always to reject these plans, so that $\alpha = 0$. But if creditors never accept low payoff plans, then the best response of managers of fluctuating earnings firms is never to offer them, so that ρ_f must be zero rather than positive. This means the only equilibrium in which perfect filtering occurs is equilibrium 1, where declining earnings firms all file under Chapter 7 and fluctuating earnings firms all offer high payoff reorganization plans under Chapter 11.

Possibilities 4 and 5 in table 1 can also be ruled out. These involve managers of fluctuating earnings firms offering only high payoff reorganization plans ($\rho_f = 0$) and managers of declining earnings firms either offering only low payoff plans or playing mixed strategies. In both situations, creditors learn that the only low payoff plans are offered by declining earnings firms. As a result, creditors' best response is always to accept these plans, so that $\alpha = 1$. But if creditors always accept low payoff plans, then the best response of managers of fluctuating earnings firms is to offer them, so that ρ_f must be positive rather than zero.

The remaining strategy combinations, possibilities 6 through 9, all are pooling equilibria and all involve filtering failure. Examine possibility 6 first. Here firms of both types offer only low payoff reorganization plans, so that $\rho_d = \rho_f = 1$. For ρ_f to equal one, α must be greater than $M/(P_h + M - P_l)$ and for ρ_d to equal one, α must also exceed $(R_d - D_d)/(R_d + G_d - C_R - P_l)$. Thus for possibility 6 to be an equilibrium, creditors must

[26] Creditors cannot engage in Bayesian learning in this case, since low payoff plans are never observed. For creditors' best response to be $\alpha = 0$, the condition in eq. (9) is replaced by the requirement that $P_l < \gamma' P_h + (1 - \gamma')(L - C_L)$.

Table 1: Equilibrium Possibilities

Declining Earnings	Fluctuating Earnings: Low payoff	Fluctuating Earnings: mixed	Fluctuating Earnings: High payoff
Chapter 7	**2** $\rho_d = 0$ $\rho_f = 1$ $\alpha = 0$	**3** $\rho_d = 0$ $0 < \rho_f < 1$ $\alpha = 0$	**1** $\rho_d = 0$ $\rho_f = 0$ $\alpha = 0$
mixed	**8** $0 < \rho_d < 1$ $\rho_f = 1$ $0 < \alpha < 1$	**9** $0 < \rho_d < 1$ $0 < \rho_f < 1$ $0 < \alpha < 1$	**5** $0 < \rho_d < 1$ $\rho_f = 0$ $\alpha = 1$
Low payoff	**6** $\rho_d = 1$ $\rho_f = 1$ $0 < \alpha \leq 1$	**7** $\rho_d = 1$ $0 < \rho_f < 1$ $0 < \alpha < 1$	**4** $\rho_d = 1$ $\rho_f = 0$ $\alpha = 1$

Table 2: Equilbrium Conditions on P_l

	Equil. 1 (PF)	Equil 6' (FF)
Declining Earnings Firms	$R_d > D_d$	$P_l < D_d + G_d - C_R$
Fluctuating Earnings Firms	$M > 0$	$P_l < P_h$
Creditors	$P_l < \gamma' P_h +$ $(1-\gamma')(L - C_L)$	$P_l > \gamma P_h +$ $(1-\gamma)(L - C_L)$

accept at least some low payoff reorganization plans but do not need to accept all such plans, so that $0 < \alpha \leq 1$. From (9), this implies that $P_l \geq \gamma P_h + (1-\gamma)(L - C_L)$. Note that creditors are more likely to accept low payoff plans as the proportion of fluctuating earnings firms in the total population, γ, falls.

In possibility 7, managers of declining earnings firms offer only low payoff plans and managers of fluctuating earnings firms play mixed strategies. For ρ_d to equal one, we must have $\alpha > \frac{R_d - D_d}{R_d + G_d - C_R - P_l}$, and for ρ_f to be between zero and one, we must have $\alpha = M/(R_h + M - R_l)$. The latter expression requires that creditors also play mixed strategies, or $0 < \alpha < 1$. Possibility 8, where managers of fluctuating earnings firms offer only low payoff plans and managers of declining earnings firms play mixed strategies, is similar. To be an equilibrium, it also requires that creditors play mixed strategies. Finally, in possibility 9, managers of both types of firms play mixed strategies and, because of this, creditors must also play mixed strategies. Since creditors' acceptance rate α must equal both α^* and α^{**}, it must be the case that the expressions in (3) and (6) are equal. Of the four pooling equilibria, possibility 9 seems least likely, since three separate knife-edge conditions for each of the three groups to play mixed strategies must be satisfied simultaneously.

A subpossibility of equilibrium 6 is that managers of both types of firms offer only low payoff reorganization plans ($\rho_d = \rho_f = 1$) and creditors accept all low payoff plans ($\alpha = 1$.) Since no group pursues a mixed strategy, no knife-edge conditions need be satisfied. Substituting $\rho_d = \rho_p = \alpha = 1$ into (2), (5) and (9), the conditions for this equilibrium, referred to as 6', can be calculated and are given in the right column of table 2.

Thus the model suggests that both perfect filtering and filtering failure may occur in bankruptcy. The only outcome involving perfect filtering is the separating equilibrium of possibility 1. The four outcomes involving filtering failure are the pooling equilibria of possibilities 6 through 9. All are economically inefficient since at least some declining earnings firms reorganize under Chapter 11.[27]

The model has interesting and somewhat counter-intuitive implications concerning managers' incentives to deceive creditors. Managers of declining earnings firms have an incentive to claim that their firms' financial condition is better than it actually is, so that proposing to reorganize rather than liquidate the firm seems reasonable. But managers of fluctuating earnings firms have an incentive to claim that their firms' financial condition is worse than it actually is, so that creditors will think that the firm can survive but cannot afford a high payoff reorganization plan. Together, managers have an incentive to claim that both types of firms are in the same financial condition. Thus managers of failing firms have incentives under different circumstances to mislead creditors by claiming that their firm's financial condition is both better and worse than it actually is.

3. Simulation of Filtering in Chapter 11 Bankruptcy

In the previous section, we established that the model had both a perfect filtering equilibrium and several possible filtering failure equilibria. In this section I investigate

[27] The results here differ from those of Gertner and Picker (1992), who emphasize the possibility that a separating equilibrium (i.e., perfect filtering) occurs, but in a somewhat different model of Chapter 11.

under what conditions filtering failure might occur in bankruptcy and whether it is likely to occur frequently. I also investigate what range of values of the low payoff rate in reorganization (P_l) is likely to occur in equilibrium. The general question of what payoff creditors receive in Chapter 11 bankruptcy reorganizations is of interest in itself. The U.S. Bankruptcy Code gives creditors the right to receive in Chapter 11 only the payoff they would get if the firm liquidated in Chapter 7, $L - C_L$. But a number of authors have recently analyzed models of the bargaining process between creditors and managers in Chapter 11 which suggest that creditors receive some or all of the firm's going concern value—*i.e.*, they receive more than $L - C_L$.[28]

To examine whether and when filtering failure occurs, I focus on equilibrium 6' since it does not require that any knife edge conditions be satisfied and therefore seems the most likely of the various filtering failure equilibria. From table 2, the conditions for equilibrium 6' are that

$$D_d + G_d - C_R > P_l > \gamma P_h + (1-\gamma)(L - C_L) \tag{11}$$

(The third condition in table 2, $P_h > P_l$, is satisfied by assumption.) I follow the procedure of adopting values for all of these variables except P_l. I then examine whether filtering failure occurs at these values and what range of values of P_l is implied by filtering failure. Separate sets of values are examined for large versus small firms in Chapter 11.

In order to make use of available data on firms in bankruptcy reorganization, I divide all the dollar values by total liabilities to creditors. The resulting variables are denoted with primes. Of these variables, the transactions cost of filing under Chapter 11 as a proportion of total liabilities, C'_R, is the best documented and most studies have found it to be around .03. I use this value for both large and small firms.[29] To establish a ballpark value of P'_h, the high payoff rate to creditors of firms in reorganization, I divide Weiss' (1990) recent sample of large firms that filed under Chapter 11 into two halves based on the payoff rates to unsecured creditors. The mean payoff rate for firms in the top half of the sample is about .80.[30] For small firms that reorganized, I follow the same procedure using LoPucki's (1983) sample and the resulting figure is around .40.[31] I therefore used .8 and .4 as the base case values of P'_h for large and small firms, respectively. Turn now to the value of $(L - C_L)'$, the amount paid to creditors if a firm in reorganization is liquidated after creditors reject managers' reorganization plan. In White's (1984) sample of small firms in bankruptcy, a number of firms filed under Chapter 11 but did not adopt reorganization plans and were sold as going concerns while remaining in Chapter 11. The average payoff rate to creditors of these firms was .13. Since large firms are rarely observed to liquidate,

[28] See Brown (1989), Baird and Picker (1991) and Bebchuk and Chang (1992). All of these models focus on an individual firm and assume that it has already filed under Chapter 11.

[29] See Wruck (1990) for a survey of the evidence.

[30] Weiss' study is of 39 publicly traded firms that filed for bankruptcy under Chapter 11. Figures are calculated from information in his Table 2 and Appendix.

[31] The top half of firms in LoPucki's sample all promised payoff rates of 100%, but with no interest and a payout period of up to 14 years—with future payments sometimes conditioned explicitly on the firm's profit level. To take account of both risk and high nominal interest rates during his sample period, I discounted the promised payoffs using a discount rate of .20.

little data is available for them. I therefore used the value $(L - C_L)' = .13$ for both large and small firms.[32]

Turn now to the government subsidy to declining earnings firms in reorganization G_d. Franks and Torous (1991) found that for a sample of large firms in Chapter 11, the mean value of NOL carryforwards as a fraction of the value of the firm was 1.13. If these carryforwards were all used immediately, they would be worth (1.13)(.34) or 38% of the firm's value, where .34 is the corporate profits tax rate. However, firms in Chapter 11 use their NOL carryforwards only after some delay and may never use them all. Altschuler and Auerbach (1990) found that the average tax rate on firms making losses is 45% of the statutory tax rate. Therefore the value of the subsidy implied by firms in Chapter 11 retaining their NOL carryforwards is assumed to be (1.13)(.34)(.45) or 17% of firm value. The other aspect of G_d—the value to failing firms of transferring their pension plans to the P.B.G.C.—is difficult to quantify. For three firms that recently filed for bankruptcy, Pan Am, Eastern and LTV, the subsidy implied by transferring their pension plans to the P.B.G.C. was 30%, 10% and 25% of total liabilities, respectively.[33] Combining these figures, but assuming that many failing firms do not transfer pension liabilities to the government, I assume a "ballpark" figure for G_d for large firms of .25. For small firms, I assume that G_d is much smaller, or .05 in the base case.

There is virtually no data available to guide the choice of D'_d, the amount that managers of declining earnings firms must pay to creditors in order to remain out of bankruptcy, as a proportion of total liabilities. I assume that creditors of large firms will monitor the firm more carefully and will therefore receive a higher payoff rate outside of bankruptcy. Therefore as a base case assumption, I use $D_d = .5$ for large firms and $D_d = .3$ for small firms.

A rough indicator of the proportion of failing firms that have fluctuating earnings γ is the proportion of all firms filing for bankruptcy under Chapter 11, which would equal γ if there were perfect filtering. This figure is .45 in White's (1984) sample of small firms, but is much higher in Weiss' (1990) sample of large firms. As a base value for γ, I therefore use .45 for small firms and .75 for large firms.[34]

Table 3 gives the results of the simulation for large firms. Using the base case values, the conditions for filtering failure (FF) are satisfied as long as P'_l is in the range .63 to .72. The next lines of the table give the results when individual variables are changed, with all other variables remaining at their base case values. Suppose first that P'_h falls from .8 to .7. Then the conditions for filtering failure are still satisfied as long as P'_l is in the range .56 to .72. Values of P'_h lower than .7 are also consistent with filtering failure. However, when P'_h rises above .92, the conditions for filtering failure no longer hold. The reason is

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[32] A recent example of a large firm that filed under Chapter 11 but eventually liquidated is Eastern Airlines, which paid nothing to unsecured creditors. See Weiss (1992).

[33] These figures are ratios of unfunded pension liabilities to total liabilities. Data are taken from 10K reports and annual reports.

[34] In Weiss' sample of 37 large firms that filed for bankruptcy, 35 filed under Chapter 11 and, of these, 30 adopted reorganization plans. A rough estimate of γ might therefore be 30/37 or around .8. Other recent studies of large firms in reorganization, such as Franks and Torous (1989), include only firms that adopted reorganization plans.

that as P_h' increases, P_l' also increases and this makes it less attractive for managers of declining earnings firms to file under Chapter 11. At values of P_h' above .92, the conditions for filtering failure no longer hold and perfect filtering is likely to occur.[35]

Now suppose G_d' rises from .25 to .35. Filtering failure still occurs as long as P_l' is in the range .63-.82. Note that an increase in government subsidies to firms in Chapter 11 implies an increase in the implied range of values of P_l', *i.e.*, the subsidies leak out of the firm at least in part. If G_d' falls below .15, however, the filtering failure equilibrium breaks down. In general, as government subsidies fall, it becomes less attractive for managers of declining earnings firms to file under Chapter 11 and therefore filtering failure is less likely to occur. Now suppose D_d' rises from .5 to .6, while other variables remain at their base values. Filtering failure still occurs as long as P_l' is in the range .63-.82. However if D_d' falls to .4 or below, the conditions for filtering failure no longer hold and perfect filtering is likely to occur.

Reductions in the liquidation value of the firm's assets $(L - C_L)'$ from .13 to .03 or increases in $(L - C_L)'$ from .13 to .5 are still consistent with filtering failure. However, if $(L - C_L)'$ rises to more than .5, then the filtering failure equilibrium breaks down and perfect filtering is likely to occur. The reason is that as the firm's liquidation value rises, creditors find it more attractive to reject low payoff reorganization plans in Chapter 11, and the decrease in α makes managers of declining earnings firms less likely to file under Chapter 11. Finally, reductions in γ to .65 or below or increases in γ up to a value of .9 are still consistent with filtering failure. But if γ rises above .9, then the filtering failure equilibrium 6' no longer holds and perfect filtering is likely to occur. The higher is γ, the more incentive creditors have to reject low payoff reorganization plans, since firms offering them are more likely to have fluctuating earnings. Nonetheless, the simulation shows that filtering failure may still occur at high values of γ.

Now turn to table 4, which gives results of the same simulation procedure using the base case values for small firms. Here the conditions for filtering failure are again satisfied in the base case as long as P_l' is in the range .25-.32. Filtering failure still occurs if P_h' falls from .4 to .3 or lower or if it rises as high as .55. Filtering failure also still occurs if the government subsidy G_d' falls to zero, as long as P_l' is in the range .21-.32. It also occurs as long as $(L - C_l)$ takes any value from 0 up to .25 or as long as γ takes any value from 0 up to .7. Thus filtering failure is also likely to occur for small firms in bankruptcy at reasonable values of the variables.

Thus the simulation results suggest that filtering failure is likely to occur in bankruptcy and that it can occur both for small and large firms. The efficiency losses associated with Chapter 11 bankruptcy reorganization may therefore be quite large. The results also suggest that both under filtering failure and perfect filtering, creditors tend to receive substantially more than the liquidation value of the firm's assets. Particularly for large firms in bankruptcy, subsidies from the government tend to "leak" out of the firm in the form of increases in the payoff rates to creditors.

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[35] For perfect filtering to occur, the conditions in the left column of table 2 must be also satisfied.

Table 3:
Simulation of Filtering Failure for Large Firms

Base case: $P'_h = .8$, $(L - C_l)' = .13$, $C'_R = .03$,
$D'_d = .5$, $G'_d = .25$, $\gamma = .75$

Values	**FF Equil.**	**Range for P'_l under FF**
base case	yes	$.63 \leq P'_l \leq .72$
$P'_h = .7$	yes	$.56 \leq P'_l \leq .72$
$P'_h > .92$	no	
$G'_d = .35$	yes	$.63 \leq P'_l \leq .82$
$G'_d < .15$	no	
$D'_d = .6$	yes	$.63 \leq P'_l \leq .82$
$D'_d < .4$	no	
$(L - C_L)' = .03$	yes	$.61 \leq P'_l \leq .72$
$(L - C_L)' > .5$	no	
$\gamma = .65$	yes	$.57 \leq P'_l \leq .72$
$\gamma > .90$	no	

Table 4:
Simulation of Filtering Failure for Small Firms

Base case: $P'_h = .4$, $(L - C_l)' = .13$, $C'_R = .03$,
$D'_d = .3$, $G'_d = .05$, $\gamma = .45$

Values	**FF Equil.**	**Range for P'_l under FF**
base case	yes	$.25 \leq P'_l \leq .32$
$P'_h = .3$	yes	$.21 \leq P'_l \leq .32$
$P'_h > .55$	no	
$G'_d = 0$	yes	$.21 \leq P'_l \leq .32$
$D'_d = .25$	yes	$.25 \leq P'_l \leq .27$
$D'_d < .23$	no	
$(L - C_L)' = 0$	yes	$.18 \leq P'_l \leq .32$
$(L - C_L)' > .25$	no	
$\gamma = .30$	yes	$.21 \leq P'_l \leq .32$
$\gamma > .7$	no	

4. Public Policy Issues in Bankruptcy

This paper has explored the implications of both Chapter 7 alone and the Chapter 7/Chapter 11 combination for type I and type II error in bankruptcy. Chapter 7 was shown to cause both types of error: type I error occurs since declining earnings firms delay shutting down too long and type II error occurs since some fluctuating earnings firms that should be saved shut down. The effect of adding Chapter 11 bankruptcy as an alternative to Chapter 7 depends on whether filtering failure or perfect filtering occurs. If perfect filtering occurs, the amount of type I error remains unaffected since managers of declining earnings firms can still delay filing for bankruptcy, but type II error drops since managers of fluctuating earnings firms are more likely to file for bankruptcy reorganization and be saved. But if filtering failure occurs, then type II error will fall but type I error will rise. This is because along with economically efficient firms, some inefficient firms are also saved in Chapter 11. Filtering failure occurs in bankruptcy because creditors are assumed not to know whether failing firms have declining or fluctuating earnings. Thus when policymakers attempt to reduce type II error by adopting a policy such as Chapter 11 which attempts to save economically efficient but failing firms, they are likely to waste resources by delaying the demise of economically inefficient firms.

Whether bankruptcy policy should be concerned with minimizing type I or type II error in bankruptcy—or some combination of the two—should depend on the relative cost of the two types of bankruptcy error. The cost of type I error is stagnation—economically inefficient firms continue to operate and tie up resources that could otherwise move to higher value uses. The cost of type II error is temporary disruption. Economically efficient firms shut down, throwing their employees out of work and disrupting the nexus of relationships between firms and their workers, suppliers and customers. However these disruption costs may not last long, since it is worthwhile for the firms' new owners to reopen them after bankruptcy.

Policy makers in the U.S. have tended to be more concerned with minimizing type II than type I error. In designing Chapter 11 of the U.S. Bankruptcy Code, Congress apparently viewed all or most failing firms as worthy of being saved, so that the cost in type I error of reducing type II error in bankruptcy was not considered. Chapter 11's provisions giving existing managers control over the firm in the early stages of reorganization were explicitly intended to attract managers to file under Chapter 11.[36] Legislators' concern with saving failing firms is not surprising: from policymakers' viewpoint, the costs of type I error, particularly job loss, are much more salient than the costs of type II error, which are long-term and hidden. Nonetheless, the analysis suggests that saving failing firms under Chapter 11 has high costs. In particular, large government subsidies to firms in Chapter 11 bankruptcy encourage abuse and are likely to be both wasteful and inefficient. Such subsidies tend to leak out of the firm in the form of higher payoffs to creditors and, even to the extent that they remain with the firm, they raise the level of type I error by

[36] From the legislative history of the 1978 Bankruptcy Code: "(The) proposed Chapter 11 recognizes the need for the debtor to remain in control to some degree, or else debtors will avoid the reorganization provisions in the bill until it would be too late for them to be an effective remedy." H.R. Rep. No 595, 95th Congress, 1st Sess. 117-8 (1977), at 231. Quoted in LoPucki (1983), p. 265.

encouraging economically inefficient firms to reorganize in bankruptcy.[37]

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[37] A number of writers have recently advocated abolishing or drastically changing Chapter 11. See Baird (1986), Jackson (1986) and Bebchuk (1988). See White (1992) for discussion of European bankruptcy procedures, which in contrast to the U.S., are not oriented to saving failing firms.

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