Toeholds and Fire-Sales in Bankruptcy Auctions

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Abstract

We study the role of distressed bank debt in affecting the outcome of Swedish bankruptcy auctions. The auction determines the going-concern premium, i.e., the premium over the piecemeal liquidation value to be paid for the right to acquire the bankrupt firm as a going concern. We show that since the distressed debt is akin to an equity position ('creditor toehold'), the bank has an incentive to finance a bidder and to induce the coalition to overbid. Moreover, the coalition's optimal bid equals the revenue-maximizing reservation price of a monopolist seller of the bankrupt firm. The empirical analysis identifies significant creditor toehold effects: the greater the toehold, the greater the winning going-concern premium, as predicted. Moreover, controlling for the creditor toehold, there is no evidence that the going-concern premium is lower in business cycle downturns, in distressed industries, for sales back to the firm's old owners, or when sold to industry outsiders. Thus, there is no support for asset fire-sale arguments, possibly because bidding with creditor toehold helps counteract fire-sale tendencies in relatively illiquid auctions.

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"...the policy of automatic auctions for the assets of distressed firms, without the possibility of Chapter 11 protection, is not theoretically sound", Shleifer and Vishny (1992).

1 Introduction

In Sweden, insolvent firms that fail to restructure their debt claims out-of-court are sold in a cash-only bankruptcy auction. The auction establishes the going-concern premium, i.e., the premium over the piecemeal liquidation value to be paid for the right to acquire the bankrupt firm as a going concern. These auctions typically involve multiple bidders: as shown below, the number of actual bids in going-concern sales averages 3 with an additional 3 bidders expressing interest in bidding. The economic efficiency of this mandatory auction system is an important but controversial issue. As pointed out by Jensen (1991), Bradley and Rosenzweig (1992)) and others, a mandatory auction system avoids costly pro-management biases inherent in a Chapter-11 type of system with court-supervised debt renegotiations. This argument receives empirical support by Thorburn (2000). She finds that Swedish bankruptcy auctions have relatively low direct costs and produces favorable debt recovery rates and going-concern survival rates compared to Chapter 11 cases. On the other hand, Shleifer and Vishny (1992) and Aghion, Hart, and Moore (1992) argue that liquidity problems and lack of competition tend to promote asset fire-sales, a possibility not directly addressed by Thorburn's evidence. Strömberg (2000) reports that sale-backs of bankrupt firms to their old owners increase in periods of industry distress in Sweden, and conjectures that such sale-backs help avoid asset fire-sales. However, direct evidence on the fire-sales hypothesis in the context of bankruptcy auctions is elusive.[1]

Strömberg (2000) recognizes that the bank has an incentive to influence the sale of the bankrupt firm and that this incentive depends on the bank's expected recovery rate. However, his analysis treats auction prices as exogenous to the bank, thus ignoring a potentially important price impact of the bank's incentives. In this paper, we instead model optimal bidding strategies and show that the final auction price indeed depends on the bank's actions. Exploiting the nature of distressed debt as an equity position—or 'creditor toehold'—in the bankrupt firm, we show that this toehold induces

[1]Evidence on the fire-sale hypothesis is sparse regardless of the context. A notable exception is Pulvino (1998), who finds that airplane sales take place at relatively low prices (relative to a model-price benchmark) in periods of industry distress. See also Maksimovic and Phillips (1998) for an interesting examination of asset fire-sale arguments using company plant data.

the bank to form a bidder coalition that bids aggressively. This is analogous to the results derived by Burkart (1995) and Singh (1998) in the context of takeover bidding with (exogenous) equity toeholds and private bidder valuations.[2] In addition, we link this toehold effect to standard auction theory by showing that the bank-bidder coalition's optimal bid equals the revenue-maximizing reservation price by a monopolist seller. The bottom line is that the impaired debt claim pushes the bank to get involved in the bankruptcy auction in order to maximize the winning bid. To our knowledge, this possibility has been largely overlooked in the literature that warns of illiquidity and asset fire-sales in bankruptcy auctions.

Our empirical analysis shows that the bank frequently finances a bidder in the auction, and it reveals a significant impact of the bank's toehold on the winning bid premium. The bid premium is the ratio of the winning bid value to the piecemeal liquidation value, where the latter is provided by the bankruptcy trustee's value estimate published at the start of the auction. Thus, at the beginning of the auction, bid strategies are conditioned on the debt recovery rate implied by the piecemeal liquidation value estimate. This 'initial recovery rate' is common knowledge and exogenously given by the bankruptcy event.[3] As a result, the cross-sectional variation (across auctions) in this recovery rate fully captures the incentives of the banks in the auction. The empirical results support the theoretical prediction that the greater the bank's incentive to participate in the auction, the greater the winning going-concern premiums (through overbidding). We also find that bank financing of the winning bid has a positive impact on the winning bid premium beyond the toehold effect. These results also reject the claim by Strömberg (2000) that bank involvement in the auction is detrimental to the interest of other junior creditors.

Controlling for toehold effects, we address the fire-sale hypothesis of Shleifer and Vishny (1992). This hypothesis maintains that firms tend to file for bankruptcy at a time when there is widespread illiquidity in the firm's industry. As a result, the firm risks being sold to industry outsiders that may be less efficient in managing the firm's assets and thus may place relatively low bids in the auction. We examine whether the going-concern premium depends on buyer identity, industry liquidity and

[2]Bulow, Huang, and Klemperer (1999) analyze overbidding with equity toeholds in common-value auctions, and Betton and Eckbo (2000) perform a large-sample empirical analysis of the effects of equity toeholds on takeover bids.

[3]The initial recovery rate is exogenous in that it does not reflect prior strategic debt trades anticipating the bankruptcy auction. Swedish debt markets are illiquid and "vulture funds" do not exist. The exogeneity of the initial creditor toehold contrasts with the endogenous nature of *equity* toeholds in corporate takeover contests which are often acquired through a complex dynamic strategy prior to the contest itself [Betton and Eckbo (2001)].

aggregate demand conditions represented by the business cycle. As argued by Maksimovic and Phillips (1998), while bankruptcies may be caused by inefficient management, they may also be a result of low product demand (which affect efficient firms as well). Thus, the probability of inefficient bankruptcy outcomes (such as asset fire-sales) should be greater in periods of depression. Our sample period includes two distinct business cycle regimes in Sweden–a boom followed by a major recession. Overall, we find no support for the fire-sale argument. Since our model suggests that banks have a greater incentive to "make the market" for the auctioned firm the more severely distressed their debt claim, a consistent explanation for this evidence is that bidding with creditor toehold effectively counteracts a tendency for asset-fire sales.

The rest of the paper is organized as follows. Section 2 discusses the incentives of the bankrupt firm's bank, derives optimal bidding strategies for a coalition between this bank and a bidder in the auction, and summarizes the central empirical hypotheses to be tested. Section 3 provides a description of the Swedish auction bankruptcy system and of our data. Section 4 presents test of empirical hypotheses related to the bank's bidding and refinancing behavior, as well as the asset fire-sale hypothesis. Section 5 concludes the paper.

2 Creditor toeholds and overbidding

2.1 Theory

Swedish bankruptcy auctions are open, ascending (English) auctions. A result in auction theory is that, with costless bidding, the outcome of this auction structure is equivalent to the outcome of a second-price, sealed-bid auction.[4] In a second-price auction, the winner pays the price at which all other bidders drop out. The same result emerges from a first-price ascending auction where the highest-valuation bidder eventually wins by matching the second-highest valuation bidder's final price. We follow Hirshleifer (1995) and refer to this as the "ratchet solution". For simplicity, the analysis below uses the second-price auction analogy.

We assume that the number of bidders is exogenously determined at two.[5] The two bidders 1 and 2 value the bankrupt firm at $v_1 \equiv v_l + \epsilon_1$ and $v_2 \equiv v_l + \epsilon_2$, respectively, where v_l is a

[4] See, e.g., Burkart (1995). Klemperer (2000) provides an extensive review of auction theory.

[5] Thus, we abstract from dynamic entry strategies by non-toehold bidders. As discussed by Bulow, Huang, and Klemperer (1999) asymmetric toeholds may exacerbate winner's curse problems and deter entry.

common value component—henceforth labeled the "piecemeal liquidation value". Moreover, ϵ_1 and ϵ_2 are i.i.d. private valuations with distribution and density functions G and g, respectively. The private valuations represent unique synergy effects emanating from the respective bidders' specialized resources when combined with the bankrupt firm. Since we interpret v_l as the piecemeal liquidation value, the private value components ϵ_1 and ϵ_2 represent the *going-concern premium.* In other words, the auction establishes the price to be paid for the right to generate the respective bidder's private going-concern value.

Suppose the liquidation value v_l is sufficient to pay off all debtholders senior to the firm's bank but insufficient to pay off the bank's own claim. Moreover, suppose the bank is the only creditor in its priority class. In this case, the bank is effectively the "residual claimant" and a monopolist seller of the firm in the auction. Proposition 1 derives the revenue-maximizing reservation price of such a seller in our auction setting.

Proposition 1 (Monopolist seller's reservation price): *Suppose the seller faces a single bidder whose private value v is distributed according to $G(v)$. Moreover, suppose that the monopolist foregoes the value v_m by selling the firm. Then, the optimal reservation price for take-it-or-leave-it offer to purchase the bankrupt firm equals*

$$p_m^* = v_m + \frac{1 - G(p_m^*)}{g(p_m^*)}. \tag{1}$$

Proof: The proof of Proposition 1 is illustrated in Figure 1. A sales price of p yields expected revenue of $R = p[1 - G(p)]$ and expected marginal revenue of $\partial R/\partial p = [1 - G(p)] - pg(p)$. The expected cost equals $C = v_m[1 - G(p)]$,[6] and the expected marginal cost equals $\partial C/\partial p = -v_m g(p)$. Equating marginal revenue with marginal costs yields the monopolist's reservation price.[7]

Enforcing p_m^* means refusing to sell the firm (or its assets) at a price below p_m^*. In the case of our bankruptcy auctions, such a commitment is not credible: The auctioneer, whose fiduciary responsibility is to maximize total creditor recovery, will in practice consider any bid value in excess

[6] The value v_m may be a competing bid or the seller's own private valuation of the firm.

[7] To ensure uniqueness, G must be twice continously differentiable and satisfy the monotonicity condition

$$\frac{\partial}{\partial v_i} \frac{g(v_i)}{1 - G(v_i)} \geq 0.$$

of the piecemeal liquidation value v_l. Thus, as a passive bystander, the bank expects to receive the lesser price equal to the second-highest bidder's valuation (the ratchet solution).

However, suppose the bank enters into a coalition with one of the two bidders, e.g., through a financing arrangement with bidder 1. The bank learns v_1, provides debt-financing of the bid, and gets to jointly determine the bid strategy. Proposition 2 shows that the coalition optimally overbids and that the price with overbidding is identical to the monopolist seller's reservation price.[8] Thus, forming a bidder coalition effectively enforces the bank's reservation price as a seller in the auction.

Proposition 2 (Overbidding with single-creditor coalition): *Let b and s denote the face values of the debt held by the bank and creditors senior to the bank, respectively, If $v_1 \geq s+b$, then the coalition does not overbid and the optimal price equals $p_c^* = v_1$. If $v_1 < s+b$, then the coalition overbids:*

$$p_c^* = v_1 + \frac{1 - G(p_c^*)}{g(p_c^*)}, \tag{2}$$

and $p_c^* \leq s+b$.

Proof: When $v_1 \geq s+b$, the bank receives full recovery and the coalition bids $p_c^* = v_1$ (the ratchet solution).[9] To derive the optimal bid strategy when $v_1 < s+b$, denote the coalition payoff as Π_c^L and Π_c^W if it loses or wins the auction, respectively, with a bid of p_c. Given the second-price auction, if the coalition loses, the winner pays the coalition bid p_c and the bank recovers the residual after paying off s to senior creditors:

$$\Pi_c^L = p_c - s. \tag{3}$$

If the coalition wins, it receives its valuation v_1, pays the losing bidder's price $p_2 = v_2$, and the bank recovers the residual $p_2 - s$:

$$\Pi_c^W = v_1 - p_2 + (p_2 - s) = v_1 - s. \tag{4}$$

[8]The compensation required to make the bank's coalition partner agree to an overbidding strategy is derived in Proposition 4, below.

[9]In this case, a dollar overbidding would be captured by creditors junior to the bank.

The expected profit from bidding p_c equals

$$\Pi_c = [1 - G(p_c)](p_c - s) + G(p_c)(v_1 - s) = [1 - G(p_c)]p_c + G(p_c)v_1 - s. \quad (5)$$

Maximizing w.r.t. p_c yields the first-order condition:

$$\frac{\partial \Pi_c}{\partial p_c} = [1 - G(p_c)] - p_c g(p_c) + v_1 g(p_c) \quad (6)$$

Solving for the optimal price yields the expression for p_c^* stated in the Proposition.[10] Moreover, it immediately follows that $p_c^* \leq s + b$, because if $p_c^* > s + b$, an additional dollar overbidding implies that the coalition bears the full cost of the reduced chance of losing to the rival bidder, while junior creditors capture the additional dollar when the coalition loses.[11]

In our Swedish bankruptcy cases, the bank is always the sole member of its creditor class. However, the above results are easily extended to the case with multiple creditors in the same debt class, and where the bank holds only a fraction $0 < \alpha < 1$ of the claims b.[12] As shown below, this reduces the coalition's overbidding.

Proposition 3 (Overbidding with multiple creditors): *The smaller the fraction α of the claims in the bank's debt class that is owned by the bank, the smaller the amount of overbidding by the bank-bidder coalition:*

$$p_c^* = v_1 + \alpha \frac{1 - G(p_c^*)}{g(p_c^*)} \leq s + b. \quad (7)$$

Proof: As in Proposition 2, overbidding occurs only when $v_1 \leq s + b$. The coalition's payoffs when

[10]In the case of the uniform distribution over the interval $[0, 1]$, the optimal bid simplifies to

$$p_c^* = \frac{v_1 + 1}{2}.$$

[11]To see that the bank—as a seller—is better off overbidding with the coalition, note that

$$\Pi_c = min[p_c^*, v_2] - s \geq min[v_1, v_2] - s.$$

That is, since $p_c^* > v_1$, the bank's revenue from overbidding is greater than the revenue implied by the ratchet solution.

[12]For example, this corresponds to a situation where a subset of same-class creditors form a coalition with management to acquire a firm out of Chapter 11. This scenario is analyzed by Hotchkiss and Mooradian (1999).

losing or winning are now scaled with the constant α, i.e.,

$$\Pi_c^L = \alpha(p_c - s) \tag{8}$$

$$\Pi_c^W = v_1 - p_2 + \alpha(p_2 - s) = v_1 - (1-\alpha)p_2 - \alpha s. \tag{9}$$

The expected payoff equals

$$\Pi_c = [1 - G(p_c)]\alpha p_c + G(p_c)v_1 - (1-\alpha)\int_0^{p_c} p_2 dG(p_2) - \alpha s. \tag{10}$$

The partial derivative $\frac{\partial \Pi_c}{\partial p_c}$ equals

$$\alpha[1 - G(p_c)] - \alpha p_c g(p_c) + v_1 g(p_c) - (1-\alpha)p_c g(p_c) = \alpha[1 - G(p_c)] + v_1 g(p_c) - p_c g(p_c), \tag{11}$$

which when set equal to zero yields the optimal coalition bid p_c^* as stated in the proposition.[13]

It is interesting to note that the expression for the optimal bid in equation (8) is identical to the optimal bid by a toehold bidder in a takeover contest derived by Burkart (1995). The intuition is as follows. Overbidding raises the probability of winning the auction at a price exceeding the bidder's private valuation. In the case of our bank-bidder coalition, the fraction α of the resulting overpayment cost is recovered by the bidding coalition (it is paid to the bank). Similarly, α of the overpayment cost in the case of Burkart (1995)'s equity toehold bidder is "recovered" as the bidder only bids for $1 - \alpha$ of the target shares. In both cases, the overbidding cost falls as α increases.

In the case of our bidder coalition, the value of α may very well equal one (as in our Swedish data). However, for equity toeholds, the range of values of α producing overbidding is limited by the bidder's willingness to sell his toehold should the bid fail. For example, overbidding is unlikely to take place in a minority buyout where the majority owner is prepared to pay the minority shareholders' reservation price.[14]

The above analysis assumes that the bank's coalition partner (bidder 1) agrees to a bidding

[13] With uniform distributions over $[0, 1]$,

$$p_c^* = \frac{v_1 + \alpha}{1 + \alpha}.$$

[14] Recall that overbidding requires a rival bidder to purchase your toehold should your bid fail. Minority buyouts attract rival bids only if the minority buyout attempt signals that the entire target firm is being put up for sale.

strategy that maximizes the total coalition payoff. Since bidder 1 derives no gain from overbidding, the bank must agree to bear the full coalition cost of overbidding. For example, this can be accomplished by reducing the expected value of the bank's debt claim issued on bidder 1 by the full amount of the coalition's expected overbidding cost.

Proposition 4 (Expected overbidding cost): *The expected overbidding cost (borne by the bank) is given by*

$$\int_{v_1}^{p_c^*} (p_2 - v_1) dG(p_2) = (p_c^* - v_1) g(p_c^*). \tag{12}$$

Proof: As illustrated in Figure 2, overbidding is costless for the coalition when it loses the contest to the rival bidder. Moreover, winning with overbidding is also costless when the winning price equals the valuation of the second-best bidder (i.e., when overbidding results in the ratchet solution). However, overbidding is costly for the coalition in the single inefficient outcome in Figure 2, where the coalition wins paying a price exceeding its own private valuation v_1. Thus, the expected cost of overbidding equals the overpayment $p_2 - v_1$ times the cumulative probability that the second bidder's valuation v_2 is in the interval $[v_1, p_c^*]$, which is shown in the proposition. Notice also that this value equals the shaded triangular area in Figure 1 under the demand curve and above the monopolist's opportunity cost over the range $[1 - G(p_m^*), 1 - G(v_m)]$.

It is not uncommon for the owners of small firms in Sweden to raise bank financing by personally guaranteeing the bank loan. If such an owner decides to bid for the bankrupt firm, the bidder effectively has a toehold much like the bank itself. If the bank forms a coalition with such a bidder, then the above analysis goes through with the exception that the bank no longer compensates the coalition bidder for the full overbidding cost. This follows because the greater bank recovery resulting from (successful) overbidding also reduces the equityholders liability vis-a-vis the bank. Note also that if the bank-bidder coalition faces competition from a bidder with a personal loan guarantee, then *both* bidders in the auction have an incentive to overbid.

2.2 Hypotheses

H1 (Toehold bidding): *Let $ln(p/v_l)$ denote the going-concern premium over the piecemeal liquidation value v_l paid by the winning bidder in the auction. Ceteris paribus,*

$ln(p/v_l)$ is decreasing in the bank's recovery rate r_l implied by the piecemeal liquidation value, where $r_l \equiv max[0, min[(v_l - s)/b, 1]$.

Motivation: Recall that the bank has an incentive to form a coalition and overbid only when $v_1 < s+b$, i.e., when $\epsilon_1 < \epsilon_1^* \equiv max[s+b-v_l, 0]$. Thus, for the purpose of computing the expected amount of overbidding, the relevant range for ϵ_1 is $[0, \epsilon_1^*]$. For a given v_l, the expected amount of overbidding is given by

$$\int_0^{\epsilon_1^*} \frac{1 - G(\epsilon_1)}{g(\epsilon_1)} d\epsilon_1. \tag{13}$$

Since the limit ϵ_1^* is decreasing in v_l, the expected amount of overbidding is also decreasing in v_l, as depicted in the upper part of Figure 3. Note also that for $r_l > 0$,

$$r_l = 1 - \frac{\epsilon_1^*}{b}. \tag{14}$$

Thus, when regressing (cross-sectionally) the going-concern premium $ln(p/v_l)$ paid by the winning bidder on the bank's recovery rate at the liquidation value r_l, the predicted sign of the regression coefficient is negative. The lower part of Figure 3 illustrates the decrease in the amount of expected overbidding as v_l approaches the limit $s + b$.

The prediction summarized in **H1** is a direct consequence of our assumed auction structure. Strömberg (2000) provides a competing set of assumptions concerning the sale of the bankrupt firms. Specifically, in Strömberg's analysis, the bankrupt firm is either sold back to the firm's old owners (a "sale-back") at a certain price or it is "liquidated" in an open auction. The sale-back price is exogenously given as the expected auction (liquidation) price. While the sale-back option is risk free, the liquidation auction has downside risk for the bank which is greater the higher the bank's debt recovery at the expected liquidation price. This induces a bias in favor of a sale-back for high expected debt recovery rates. We summarize this prediction as follows:

H2 (Sale-back bias): *As in Strömberg (2000), suppose the bank has the option of selling the firm back to the old owners at a price equal to the expected price of an open bankruptcy auction. The likelihood of sale-backs decreases with the number of potential bidders, and increases with the bank's expected recovery rate. Moreover, since the sale-*

back takes place without competing bids, the going-concern premium in the average sale-back price is lower than the average premium produced by going-concern auctions.

Finally, we examine the asset fire-sale argument of Shleifer and Vishny (1992) and others. This hypothesis maintains that firms tend to file for bankruptcy at a time when there is widespread illiquidity in the firm's industry. As a result, the firm risks being sold to industry outsiders that may be less efficient in managing the firm's assets and thus may place relatively low bids in the auction.

H3 (Fire-sales): *The going-concern premium $ln(p/v_l)$ established in bankruptcy auctions decreases with industry distress, with business cycle downturns, and is lower when the buyer in the auction is an industry outsider.*

We now turn to an empirical analysis of these hypotheses.

3 Swedish auction bankruptcy: Structure and data

3.1 Auction structure

Figure 4 illustrates key potential outcomes in a Swedish firm's process towards being sold in a bankruptcy auction, starting with the point of insolvency. The insolvent firm (i.e., a firm where the face value of debt claims exceeds the market value of the assets) may first consider attempting to use the *composition* option (event 1) provided by Swedish insolvency law. This option allows the firm to renegotiate the debt claim of *junior* (unsecured) creditors. However, successful composition is elusive as senior creditors are not part of the proposal and need not agree unless they are offered full repayment. Since anything less than full repayment implies a wealth transfer from senior to junior creditors, composition is almost never attempted. Indeed, Eckbo and Thorburn (2000) report 300 bankruptcy filings but only four successful composition attempts in the population of 1,650 financially distressed Swedish firms with at least 20 employees during 1990-92.

Failing composition, the firm may explore the potential for negotiating an out-of-court sale of the firm's assets as a going concern (event 2). This negotiation is typically initiated by the owner-manager and is subject to approval by secured creditors, which include the firm's main bank. Following this sale, the firm is still insolvent (the cash proceeds from the sale are necessarily less than the face value of outstanding debt) and must thus file for bankruptcy (event 3). This filing represents a *prepackaged bankruptcy* solution (”auction prepack”) since the assets have already been sold.[15] The role of the bankruptcy court in this instance is primarily to allow junior creditors to object to the sale and, if the sale is disproved, to organize an open auction. Empirically, auction prepack filings are almost never overturned.

Thorburn (2000) shows that auction prepacks have significantly lower direct costs than a regular bankruptcy filing. Thus, it is natural to assume that a regular auction bankruptcy filing (event 4) signals a failed prepack attempt.[16] Thorburn (2000) examines whether this signal manifests itself in different recovery rates across prepacks and regular going-concern sales. She reports that prepacks have lower direct bankruptcy costs. However, she fails to find any other substantive difference in the auction outcomes.

When filing for regular auction bankruptcy, the incumbent management team is replaced by an independent, court-appointed, professional trustee who has a formal fiduciary duty towards creditors. Trustees are certified by a government supervisory authority (”Tillsynsmyndigheten i Konkurs” or TSM), who reviews the trustees' compensation and performance. Poorly performing trustees (e.g., in terms of their efforts to maintain the bankruptcy auction) risk losing their license. Trustees are also subject to the wrath of major creditors should they appear not to maintain a proper auction procedure. Thus, collusion between owner-managers and the trustee, e.g., in a sale-back to the old owners, places the individual trustee's reputation at risk. Trustees are compensated on an hourly basis.

The trustee organizes the sale of the firm in an open, ascending (English) auction, either as a going concern (event 5) or piecemeal liquidation (event 6). A going concern sale takes place by merging the assets and operations of the firm into a receiving company set up or held by the buyer, akin to a leverage buyout transaction.[17] The method of payment is restricted to cash only, and creditors are paid strictly according to the absolute priority of their claims.

While in bankruptcy, and before the asset sale, the firm is protected by an automatic stay of

[15] As reported by Thorburn (2000), the asset sale is typically completed the day before–or on the day of–the bankruptcy filing. In Sweden, the trustee's popularly refer to auction prepacks as ”knockout bankruptcy”.

[16] An important reason for a failed prepack attempt is insufficient time, following insolvency, to line up a buyer and generate the support of the major creditors.

[17] Thus, the firm's assets are transferred to the buyout firm while the debt claims remain on the books of the firm in bankruptcy.

creditors (i.e., debt service is halted and creditors cannot seize collateral.) Furthermore, debtor-in-possession financing is permitted.[18] As a result, the firm can maintain its operations while in bankruptcy and raise new capital through debt issues with super-priority status. In practice, bankrupt firms tend to cover operating expenses by increasing their debt obligations in the form of trade credits (which get super-priority), while new debt issues or bank loans are almost never observed.[19]

In Figure 4, the going-concern-sale event contains four separate sub-categories, classified as to who buys the firm (old versus new owner) and who finances the buyer (old versus new bank). With this classification, we address issues concerning the bank's incentive to finance the buyer, and whether the winning bid in the auction reflects the incentives to overbid, as discussed above. These issues are discussed below.

3.2 Data sources and characteristics

The starting point for our sample of Swedish bankruptcies is the original Strömberg and Thorburn (1996) data base also underlying Thorburn (2000), Thorburn (1999) and Strömberg (2000). This data set includes a total of 263 bankruptcies from 01/88–12/91, selected from a population of 1,159 bankrupt firms having at least 20 employees. The source of the population is Upplysnings-Centralen AB (UC), and the Strömberg-Thorburn sample is restricted to bankruptcies in the four largest administrative provinces in Sweden, including the country's three main metropolitan areas, Stockholm, Gothenburg and Malmö. The sample firms are among the largest in Sweden: only 6% of Swedish corporations have 20 employees or more. All firms are privately held, and most have concentrated ownership.[20]

Strömberg-Thorburn collect case-specific information from the official bankruptcy files kept by TSM. However, these files do not contain sufficient information on key characteristics for this paper,

[18] We thank Torgny Håstad, Swedish Supreme Court judge and former professor of law at the University of Uppsala, for pointing this out to us.

[19] In Sweden, as in most of Western Europe, bank financing often take the form of so-called "floating-charge" secured debt. "Floating charge" does *not* refer to the interest on the debt but rather to the definition of the assets pledged as collateral. A "fixed-charge" collateral would refer to a case where the debt is secured in a certain asset (e.g., a building) and represent the typical form of collateral in the U.S.. "Floating-charge" collateral refers to the movable assets of the firm (machinery, inventory, etc.) which tend to automatically change over time with the firm's operations.

[20] The sample firms are small in absolute terms. The book value of total assets one year prior to filing averages $2.5 million, and the number of employees averages 43.

such as the number of bidders, the duration (number of days) of the auction, and the financing of the winning bid (old bank versus new bank). As a result, we requested detailed information from each individual trustee across the 263 bankruptcies. To date, we have received responses covering 113 individual auctions. As shown in Figure 5, in a substantial number of cases, the number of potential buyers expressing an interest in submitting a bid exceeds 1. As listed in Table 1, the average number of interested bidders equals 5.5 with a median of 3. Moreover, as illustrated in Figure 6, the substantial expression of interest translates into multiple bids (more than one) in a majority of the auctions. The average number of actual bids equal 3.6 with a median of 2.0. The duration of the bidding averages 27 days.

When asked to characterize the nature of the auction process itself, the typical response of the trustees is that the firms are sold in an open, ascending auction. Interestingly, the trustees view also the typical sale-back as resulting from an open auction procedure, i.e., in competition with other actual or potential bids. This is important as it confirms our assumption that the bankruptcy auction process encompasses sale-backs as well as sales to new owners. The view of the trustees is also directly supported by the frequency distribution for the number of bids shown in Figure 6.

Furthermore, our empirical analysis requires information on the old bank's decision to finance the bidder in going-concern auctions. This information is drawn in part from Thorburn (2000) and from the trustees' responses. The information includes whether the buyer being financed represents the old owner/manager or new investors. Thorburn (2000) collects this information from the national register of corporate floating charge claims ("Inskrivningsmyndigheten för företagsinteckning"). Of the 200 going concern sales listed in Table 1, the bank financing of the winning bid is identified for 117 cases. Also, we incorporate information on the equity ownership of incumbent CEOs compiled by Thorburn (2000).

Our measures of industry distress exploits the complete financial statements of the population of more than 15,000 Swedish firms with at least 20 employees. The industry distress factor is a continuous variable measuring the fraction of firms in the industry that either reports an interest coverage ratio less than one or files for bankruptcy in the same calendar year. The industry is defined on either a 2-digit or a 4-digit level.[21] The source of this information is UC. The industry information is also used to estimate the relative accounting (operating) performance of bankrupt

[21] Swedish industry classifications mirrors the SIC code system used in the US.

firms.

Finally, we extend the Strömberg-Thorburn data base with information on the business cycle. We construct a monthly, composite business cycle index from a set of factors that includes consumer and producer price indices, gross national product, and inflation. The source of this information is Statistics Sweden.

The sample firms represent more than 30 different 2-digit SIC groups, with 29% in manufacturing industries, 24% in construction and wholesale industries, 10% in the hotel and restaurant industry, 10% in the transportation industry, and the balance of 27% scattered across a number of other industries.

Table 1 shows the number of cases across the outcomes depicted in Figure 4. Of the 263 bankrupt firms in the sample, 53 (20%) succeeded in performing a prepack while the remaining 80% submitted a regular auction bankruptcy filing. Of 207 regular filings, 60 (29%) are liquidated piecemeal and 147 (71%) are sold as a going concern.[22]

4 Empirical analysis

4.1 Auction premiums and average recovery rates

Table 2 lists the average and median values of the auction premium and total recovery rates classified by bankruptcy outcome (going-concern sales, prepacks, and piecemeal liquidations) and the identity of the buyer (old or new owner). We define the auction premium as the winning bid price p in percent of the trustee's liquidation value estimate of the assets sold in the auction, $\hat{v}_l^a$, i.e., $p/v_l^a - 1$. With few exceptions, the auction excludes accounts receivables and other financial claims, thus $\hat{v}_l^a < \hat{v}_l$. Table 2 does not list the value of the going-concern premium for auction prepacks since the trustee's liquidation value estimate is made when the prepack sales price is known.

The average value of the auction premium ranges from a low of 8% for piecemeal liquidations to a high of 131% for going-concern sales to old owners (sale-backs). Note that the 8% premium (median 2%) for piecemeal liquidations supports our contention that the trustee's liquidation estimate is just that; a good estimate of the winning bid value in a piecemeal liquidation auction. Notice also

[22]Three regular filings cannot be classified as to their going-concern-sale status due to insufficient information in the court documents.

that the high premium in sale-backs fails to support arguments suggesting that the bank somehow short-cuts the auction mechanism by financing the old owner and acquires the firm at relatively low prices.

Table 2 also shows the average and median values of three recovery rates. The first is the total debt recovery rate (column 2), computed as $r \equiv max[0, min[p/f, 1]] \in [0, 1]$, where f is the face value of the firm's total outstanding debt. The average value of r ranges from a low of 26% for piecemeal liquidations to a high of 40% for going-concern sales to new owners.[23] Furthermore, column 3 of Table 2 shows the *bank's* total recovery rate, $r_b \equiv (p - s)/b$, which ranges from a low of 46% in piecemeal liquidations to a high of 77% in auction prepacks. Thus, the bank recovers substantially more (and junior debt substantially less) than the average for the firm as a whole. Finally, column 4 lists the bank's recovery rate at the liquidation value defined as $r_{bv} \equiv (\hat{v}_l - s)/b$ where s and b are the face values of the debt senior to the bank and of the bank, respectively. Note that r_{bv}, which is used below to compute the bank's toehold value, represents a lower bound on the bank's recovery rate since it ignores the going-concern premium produced by the auction. The average value of r_{bv} ranges from a low of 45% in piecemeal liquidations to a high of 67% in sale-backs.

4.2 Outcome probabilities and expected recovery rates

Let $\bar{r}_n$ denote the average bank recovery rate in auction outcome n. Moreover, let $\pi_n(x_j)$ denote the probability of auction outcome n conditional on some vector of firm-specific characteristics x_j. The conditional expected value of the toehold is computed as $E(t_j) = \sum_{n=1}^{3} \pi_n(x_j)\bar{t}_n$.

We first estimate $\pi_n(x_j)$ using the following multinomial logit model across the three main auction outcomes (piecemeal liquidation, auction prepack, going-concern sale):

$$\pi_{jn} = \pi_n(x_j) = \exp(x_j'\beta_n) / \sum_{n=1}^{3} \exp(x_j'\beta_n) \tag{15}$$

where β_n is a $(K = 7 \times 1)$-vector of parameters. Table 3 gives summary statistics for the seven

[23] See Thorburn (2000) for a cross-sectional analysis of the total recovery rates in our sample.

variables in the vector x, defined as follows:

$$x' \equiv [constant,\ size,\ profmarg,\ secured,\ float,\ bcy1991,\ distress], \tag{16}$$

where *size* is the natural logarithm of the bankrupt firm's total assets as indicated in the last financial statement prior to filing; *promarg* is the industry-adjusted profit margin, defined as pre-filing gross margin (EBITDA divided by total sales) minus the contemporaneous median gross margin of all Swedish firms with at least 20 employees and the same 4-digit industry code as the sample firm; *secured* is the proportion of the total debt that is secured; *float* is the number of floating charge debt holders; *bcy*1991 is a binary variable with a value of one if the bankruptcy filing in 1991 and zero otherwise; and *distress* is an industry distress variable measured as the fraction of Swedish firms with more than 20 employees sharing the same 2-digit SIC code industry that either reports an interest coverage ratio of less than one in the year of the bankruptcy filing or files for bankruptcy during that calendar year.

The logit model cannot be estimated directly as the parameters β_n are determined only up to an additive constant (i.e., one can add a constant α to each β_n without altering the estimated value of π_{jn}). The solution is to fix the set of parameters associated with one of the outcomes, and rescale the remaining parameters relative to that "numeraire" outcome. Throughout the analysis, we select the piecemeal liquidation outcome as the numeraire outcome ($n = 1$). Let $\dot{\beta}_n$ denote the parameter value rescaled in this manner. Thus, $\dot{\beta}_1 = 0$, and $\dot{\beta}_n = \beta_n - \beta_1$, for $n = 2, 3$. The multinomial logit model is then:[24]

$$\pi_{j1} = 1/[1 + \sum_{n=2}^{3} \exp(x_j' \dot{\beta}_n)], \tag{17}$$

$$\pi_{jn} = \exp(x_j' \dot{\beta}_n)/[1 + \sum_{n=2}^{3} \exp(x_j' \dot{\beta}_n)] \quad \text{for} \quad n = 2, 3. \tag{18}$$

Panel I of table 4 shows the estimated coefficient values in the vector β for each of the two outcomes

[24]Generally, the likelihood function is determined by defining an index y_{jn} which equals 1 if auction j results in outcome n, and zero otherwise. Then for a total of $\mathcal{E}$ outcomes and N bids, the likelihood function is

$$L^s = \prod_{j=1}^{N} \prod_{n \in \mathcal{E}} \pi_{jn}^{y_{jn}},$$

which (with the logit function) has a unique maximum.

auction prepack ($n = 2$) and going concern sale ($n = 3$). The values of the likelihood-ratio test statistics (LRT) indicate that the parameter estimates are jointly significant (LRT=22.10 with 12 degrees of freedom).[25]

Since the probabilities at each stage sum to one, the parameters β_n reported in Table 4 do not represent partial derivatives of the probabilities with respect to each of the offer characteristics. That is, a change in the kth offer characteristic changes *all* three probabilities simultaneously, so that the partial for one probability becomes

$$\partial \pi_n / \partial x_k = \pi_n (\beta_{kn} - \sum_{e=1}^{3} \beta_{ek} \pi_e). \tag{19}$$

Panel II in Table 4 shows the value of this partial derivative for all the probabilities and all the offer characteristics, along with the imputed t-statistics. The probability of piecemeal liquidations increase with the number of secured debtholders and with bankruptcy filings in the business cycle downturn in the year 1991. Auction prepacks are more likely the greater the bankrupt firm's asset size and the greater the proportion secured debt. The probability of an going concern sale is greater the greater the number of floating charge debtholders.

Panel I of Table 5 reports the average probabilities resulting from the multinomial estimation, as well as the probability evaluated at the mean values of the characteristics in x. Relative to the simple outcome frequency (as reported in Panel I), the multinomial analysis lowers the probability of piecemeal liquidation increases the probability of going-concern sale.

Panel II and III of Table 5 show the mean and median values of three alternative measures of the bank recover rate variable r.

$$r_{bv} = max[0, min[(\hat{v}_l - s)/b, 1]] \tag{20}$$

$$r_2 = E[\bar{r}_b] = \sum_{n=1}^{3} \pi_n \bar{r}_{bn} \tag{21}$$

$$r_3 = E[\bar{r}_{bv}] = \sum_{n=1}^{3} \pi_n \bar{r}_{bvn} \tag{22}$$

Recovery r_{bv} is the recovery rate computed at the trustee's liquidation value estimate, $\hat{v}_l$. While r_{bv}

[25]The likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The test is distributed χ^2 with degrees of freedom equal to the number of additional explanatory power.

underestimates the true recovery by leaving out the going concern premium, it has the advantage of being observable at the beginning of the auction. Moreover, precisely because it does not anticipate the auction premium, it can be used as an exogenous explanatory variable for the bank's financing decision. Recovery rates r_2 and r_3 use the pre-filing outcome probabilities π to compute the expectation. Thus, these two recovery rates are used to analyze the behavior of the bank prior to filing for bankruptcy (and thus prior to learning the trustee's liquidation value estimate). Recovery rate r_2 computes the expected recovery of the bank at the end of the auction, while r_3 computes the expected recovery using the bank recovery at the trustee's liquidation value estimate $\hat{v}_l$.

The mean (median) value of r_{bv} is 0.45 (0.39), while the corresponding values for r_2 and r_3 are 0.70 (0.70) and 0.63 (0.63), respectively. The bank receives full recovery at the trustee's estimate in approximately 80 bankruptcy filings. Moreover, in another 20 cases, the bank's receives zero recovery at the estimated liquidation value. The intermediate cases are fairly evenly distributed across the entire range between 0 and 1. In contrast, when weighting the recovery rates with the ex-ante probability estimates π, the frequency distribution centers on recovery rates of approximately 30% in the case of r_2 and approximately 36% in the case of r_3, with very low frequencies for recovery rates higher than 75% or lower than 60%.

4.3 The impact of the recovery rate on the bank's financing decision

In this section, we use multinomial logit to estimate the probability that either the old bank or a new bank finances the winning bid in the auction as a function of the expected recovery rate (either r_2 or r_3).[26] Furthermore, the vector of explanatory variables include other factor that may be important to the bank's financing decision, such as the degree of industry distress (*distress*), the firm's pre-filing industry-adjusted profit margin (*profmarg*), as well as firm size (*size*). As before, we use piecemeal liquidation as the numeraire outcome.

Table 6 reports results based on recovery rate r_2, while Table 7 shows results using r_3. In either table, Panel I shows the coefficient estimates for each of the explanatory variables, while Panel II shows the partial derivatives with respect to the same vector of explanatory variables. The most striking result from both tables is the strong impact of the expected recovery rate combined with

[26]Note that when the bank finances the winning bid, the bidder may be either the old owner-manager or a new owner. Thus, this category includes, but is not restricted to, salebacks financed by the old bank.

an insignificant impact of the other three regressors. The effect of the recovery rate, regardless of definition r_2 or r_3, is to increase the probability that the old bank finances the new bid, and reduce the probability of piecemeal liquidation. The positive impact of the recovery rate on the old bank's decision to finance the winning bid differs from the key finding of Strömberg (2000) that the probability of a saleback increases in his saleback bias variable. The effect of the recovery rate in Table 6 and 7 cannot be a saleback effect because the recovery rate pushes the bank to finance the winning bid also when the buyer is a new owner (i.e., when it is not a saleback) as well as when there are competing bids in the auction (i.e., when the saleback option is not risk-free).

We interpret the recovery effect in Tables 6 and 7 as reflecting either overbidding, bank information that bankrupt firms with high expected bank recovery are relatively valuable acquisition targets, or both. The positive impact of the expected recovery rate is consistent with overbidding because the smaller the old bank's expected recovery the greater the bank's incentive to finance relatively low valuation bidders (and push for overbidding), which in turn implies greater probability that the winning bid is actually financed by the old bank. Furthermore, the insignificance of the distress variable, which in Strömberg (2000) increases the probability of a saleback, indicates that the recovery variable fundamentally captures the impact of industry liquidity on the bank's refinancing decision.

4.4 Going-concern premiums and the fire-sale hypothesis

Table 8 and 9 show the estimated parameters in cross-sectional regressions with the auction going-concern premium as dependent variable. The auction premium is $ln(p/\hat{v}_l^a)$, as defined above. The purpose of these regressions is twofold. First, we examine to what extent recovery rates affect auction premiums as suggested by our overbidding argument. That is, smaller recovery rates lead to more aggressive bidding, and thus greater auction premiums. Secondly, we want to examine whether auction premiums are affected by fire-sales arguments. That is, to what extent does industry illiquidity, business cycle downturn and purchase of the assets by industry outsiders decrease auction premiums. The sample in both tables exclude auction prepacks because the auction premium is not well defined for prepacks (the trustee's liquidation value estimate incorporates knowledge of the final prepack price) while Panel II of each table also excludes piecemeal liquidations. The only difference between the two tables is that Table 9 excludes the variable *interest* (number of interested bidders reported by the auction trustee) and includes the variable *outsider* indicating that the winning bid is made by an industry outsider, as defined in Strömberg (2000).

Tables 8 and 9 uses the bank's recovery rate at the piecemeal liquidation value, r_{bv}. As shown, lower recovery rates lead to significantly greater auction premiums. This key result, which is robust across all regression specifications, is predicted by the overbidding theory. However, overbidding is not the only possible explanation: smaller recovery rates may be the result of firms for which growth options (i.e., going concern value) constitute a greater proportion of total assets. Recovery rates evaluated at the piecemeal liquidation value tend to be low for these firms. Thus, the negative correlation between the recovery rate and the going concern value, represented by the auction premium. Note also that there is a significant effect of bank financing of the winning bid that is independent of the recovery rate. The variable *bankfin* is consistently positive and significant, possibly indicating that the bank uses private information about the quality of the firm in its decision to finance the winning bid.

There are additional interesting results in Tables 8 and 9. First, neither the number of actual bid nor the number of interested bidders have a significant impact on the auction premium. While this finding is not predicted by theories of overbidding, it also does not contradict such theories. Second, the binary variable indicating saleback to the old owner is largely insignificant. This result rejects the suggestions by Strömberg (2000) proposition that saleback transactions take place at lower premiums. Third, the industry distress variable, the bankruptcy 1991 dummy, and the outsider variable all have coefficients that are insignificantly different from zero. This is inconsistent with asset fire-sales arguments and suggests, if anything, the initial recovery rate induces old bank participation in the auction that counteracts a tendency for fire-sales in otherwise illiquid auctions.

5 Conclusion

We study the role of distressed bank debt in affecting the outcome of Swedish bankruptcy auctions. The auction determines the going-concern premium, i.e., the premium over the piecemeal liquidation value to be paid for the right to acquire the bankrupt firm as a going concern. We show that since the distressed debt is akin to an equity position ('creditor toehold'), the bank has an incentive to finance a bidder and to induce the coalition to overbid. Moreover, the coalition's optimal bid equals the revenue-maximizing reservation price of a monopolist seller of the bankrupt firm. The empirical analysis identifies significant creditor toehold effects: the greater the toehold, the greater the winning going-concern premium, as predicted. Moreover, controlling for the creditor toehold, there is no evidence that the going-concern premium is lower in business cycle downturns, in distressed industries, for sales back to the firm's old owners, or when sold to industry outsiders. Thus, there is no support for asset fire-sale arguments, possibly because bidding with creditor toehold helps counteract fire-sale tendencies in relatively illiquid auctions.

References

Aghion, Philippe, Oliver Hart, and John Moore, 1992, The economics of bancruptcy reform, *Journal of Law, Economics and Organization* 8, 523–546.

Betton, Sandra, and B. Espen Eckbo, 2000, Toeholds, bid-jumps and expected payoffs in takeovers, *Review of Financial Studies* 13, 841–882.

———, 2001, The toehold puzzle, Working paper, Dartmouth College, NH.

Bradley, Michael, and M. Rosenzweig, 1992, The untenable case for chapter 11, *Yale Law Journal* 101, 1043–1095.

Bulow, Jeremy, Ming Huang, and Paul Klemperer, 1999, Toeholds and takeovers, *Journal of Political Economy* 107, 427–454.

Burkart, Mike, 1995, Initial shareholdings and overbidding in takeover contests, *Journal of Finance* 50, 1491–1515.

Eckbo, B. Espen, and Karin S. Thorburn, 2000, Resolution of financial distress in an auction bankruptcy environment, Working paper, Dartmouth College, NH.

Hirshleifer, David, 1995, Mergers and acquisitions: Strategic and informational issues, in Robert A. Jarrow, and Vojislav Maksimovic William T. Ziemba, ed.: *Finance*, vol. 9 of *Handbooks in Operation Research and Management Science* . chap. 26, pp. 839–885 (North-Holland).

Hotchkiss, Edith S., and Robert M. Mooradian, 1999, Auctions in bankruptcy, Working paper, Boston College, MA.

Jensen, Michael C., 1991, Corporate control and the politics of finance, *Journal of Applied Corporate Finance* 4, 13–33.

Klemperer, Paul, 2000, Auction theory: A guide to the literature, *Journal of Economic Surveys* 13, 227–286.

Maksimovic, Vojislav, and Gordon Phillips, 1998, Asset efficiency and reallocation decisions of bankrupt firms, *Journal of Finance* 53, 1495–1532.

Pulvino, Tod, 1998, Do asset fire-sales exist?: An empirical investigation of commercial aircraft transactions, *Journal of Finance* 53, 939–978.

Shleifer, Andrei, and Robert W. Vishny, 1992, Liquidation values and debt capacity: A market equilibrium approach, *Journal of Finance* 47, 1343–1366.

Singh, Rajdeep, 1998, Takeover bidding with toeholds: The case of the owner's curse, *Review of Financial Studies* 11, 679–704.

Strömberg, Per, 2000, Conflicts of interests and market illiquidity in bankruptcy auctions: Theory and tests, *Journal of Finance* 55, fortcoming.

———, and Karin S. Thorburn, 1996, An empirical investigation of swedish corporations in liquidation bankruptcy, EFI Research Report, Stockholm School of Economics.

Thorburn, Karin S., 1999, Auction bankruptcy and the CEO, Working paper, Dartmouth College, NH.

——— , 2000, Bankruptcy auctions: Costs, debt recovery and firm survival, *Journal of Financial Economics* 58, 337–368.

Table 1

Auction characteristics classified by bankruptcy outcome. Total sample of 263 Swedish firms filing for auction bankruptcy 1988-1991.

	No of cases	Average (median) no of "interested bidders" per case	Average (median) no of actual bids per case	Average (median) no of days in bidding period[1]	No of cases with old bank financing	No of cases with new bank financing	No of cases with no bank financing
I. Total sample of bankruptcy filings							
	263	5.5 (3.0)	3.6 (2.0)	27.0 (15)	62	62	3
II. Going concern auctions							
All	147	5.7 (3.0)	3.3 (2.0)	25.3 (15)	42	47	3
Sale-backs	90	5.3 (3.0)	3.0 (1.0)	23.4 (15.0)	30	29	3
New owner	50	6.2 (4.0)	3.7 (3.0)	27.0 (15.0)	12	16	0
III. Auction prepacks (going concern sales)							
All	53	1.5 (1.0)	1.2 (1.0)	n/a	20	15	0
Sale-backs	32	1.2 (1.0)	1.2 (1.0)	n/a	15	9	0
New owner	17	1.1 (1.0)	1.0 (1.0)	n/a	5	5	0
IV. Piecemeal liquidations							
	60	12.1 (6.0)	9.8 (5.0)	15.7 (10.0)			

[1] This is the number of days in the period during which the trustee accepts bids in the auction for the bankrupt firm's assets.

Table 2

Average (median) auction premiums and recovery rates classified by bankruptcy outcome. Sample of 263 Swedish firms filing for auction bankruptcy 1988-1991.

	Auction premium (%)[1]	Total recovery rate (%)[2]	Bank recovery rate (%)[2]	Bank recovery rate at $\hat{v}_l$ (%)[3]
I. Total sample of bankruptcy filings				
	96.7 (6.3)	34.5 (33.1)	69.3 (82.8)	62.2 (72.2)
II. Going concern auctions[4]				
All	125.3 (13.5)	39.0 (38.1)	76.3 (89.3)	65.6 (76.8)
Sale-backs	130.9 (13.5)	38.2 (37.2)	77.0 (97.2)	67.4 (78.0)
New owner	114.3 (6.7)	40.3 (41.0)	75.0 (83.9)	63.0 (77.0)
III. Auction prepacks (going concern sales)[4, 5]				
All	n/a	32.1 (31.3)	77.1 (91.3)	n/a
Sale-backs	n/a	28.7 (31.8)	74.5 (84.5)	n/a
New owner	n/a	36.6 (29.5)	76.7 (99.1)	n/a
IV. Piecemeal liquidations				
	7.6 (1.6)	25.6 (21.2)	45.7 (40.4)	45.3 (40.0)

[1] The auction premium is defined as $p/\hat{v}_l^a - 1$, where p is the price received in the auction and $\hat{v}_l^a$ is the trustee's liquidation value estimate of the assets sold in the auction.

[2] Recovery rate is the payoff to debtholders in bankruptcy as a fraction of the face value of the debt claims.

[3] Let $\hat{v}_l$ be the trustee's estimate of the total liquidation value of the firm (which exceeds $\hat{v}_l^a$ when assets, such as accounts receivables and other financial claims, are excluded from the auction). The bank recovery rate at $\hat{v}_l$ is defined as $r_{bv} \equiv \max[0, \min[(\hat{v}_l - s)/b, 1]]$, where *s* and *f* are the face values of the debt senior to the bank and the bank's debt, respectively.

[4] Due to missing information, the "All" categories contain more cases than the sub categories.

[5] Auction premiums as defined in this paper are not relevant for auction prepacks since the estimate of $\hat{v}_l^a$ is made after the final going concern price has been negotiated.

Table 3

Summary statistics of the explanatory variables used in multinomial logit estimation of the probability for bankruptcy outcomes prior to the bankruptcy filing.

Variable	**Mean**	**Median**	**Standard deviation**
Log of prefiling book value of assets (*size*)	15.98	15.92	1.055
Industry-adjusted profit margin (*profmarg*)[1]	-0.58	-0.40	0.137
Fraction secured debt (*secured*)	0.390	0.380	0.247
Number of floating charge debt holders (*float*)	1.14	1.00	0.650
Dummy variable indicating bankruptcy filing in 1991 (*bcy1991*)	0.59	1.00	0.490
Industry distress (*distress*)[2]	0.423	0.377	0.161

[1] The difference between the firm's profit margin, defined as EBITDA divided by sales, and the median profit margin of Swedish firms with more than 20 employees sharing the same 4-digit SIC code industry.

[2] Fraction of Swedish firms with more than 20 employees sharing the same 2-digit SIC code industry that either reports an interest coverage of less than one in the year of bankruptcy filing, or files for bankruptcy during that calendar year.

Table 4

Maximum likelihood estimates of the coefficients in a multinomial logit estimation of the probability for bankruptcy outcomes prior to the bankruptcy filing. Bankruptcy outcome is classified as piecemeal liquidation (y=1), auction prepack (y=2) or going concern sale (y=3). Panel II reports the partial derivatives of probabilities with respect to the vector of characteristics computed at the variable means. Sample of 257 Swedish firms filing for auction bankruptcy 1988-1991.

	Explanatory variables						
Bankruptcy outcome:	*constant*	*size*	*profmarg*	*secured*	*float*	*bcy1991*	*distress*
I. Coefficient estimates of explanatory variables (p-value)[1]							
Auction prepack (π_2)	-7.144	0.373	1.762	-2.400	-0.013	1.217	3.320
	(0.036)	(0.065)	(0.240)	(0.010)	(0.971)	(0.017)	(0.047)
Going concern sale (π_3)	-0.145	0.070	1.083	-1.042	0.461	0.648	1.356
	(0.668)	(0.665)	(0.312)	(0.153)	(0.099)	(0.098)	(0.320)
	N=257, Log likelihood=-245.52, LRT=-22.10, df=12						
II. Partial derivatives of probabilities with respect to vector of explanatory variables (p-value)[2]							
Piecemeal liquidation (π_1)	0.452	-0.025	-0.215	0.237	-0.059	-0.136	-0.317
	(0.320)	(0.364)	(0.247)	(0.072)	(0.224)	(0.059)	(0.181)
Auction prepack (π_2)	0.980	0.050	0.151	-0.255	-0.054	0.116	0.362
	(0.049)	(0.076)	(0.471)	(0.057)	(0.244)	(0.109)	(0.111)
Going concern sale (π_3)	0.528	-0.025	0.064	0.018	0.113	0.020	-0.046
	(0.315)	(0.428)	(0.785)	(0.902)	(0.044)	(0.801)	(0.863)

[1] The multinomial estimation necessarily normalizes to zero the coefficients for one of the outcomes (in this case piecemeal liquidation). The multinomial logit model has the following general form: $p_{jn} = \exp(x_j' b_n) / \sum_{n=1}^{3} \exp(x_j' b_n)$ where there are K=7 firm-specific characteristics in the (K×1) vector of explanatory variables x_j, β_n is the (7×1) vector of parameters, and there are a total of three possible outcomes. The likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The test is distributed as X^2 with degrees of freedom equal to the number of additional explanatory variables.

[2] The partial derivatives reported in the table are given by $\partial p_n / \partial x_k = p_n (b_{kn} - \sum_{e=1}^{3} b_{ek} p_e)$.

Table 5

Probabilities for bankruptcy outcomes implied by the multinomial logit estimation, and the mean and median values of three alternative measures of bank recovery rate.

	Piecemeal liquidation	Auction prepack	Going concern sale
I. Pre-filing probabilities (π) for auction bankruptcy outcomes			
Average probability	0.226	0.206	0.568
Probability at the mean value of x	0.221	0.192	0.587
Simple outcome frequency	0.231	0.204	0.565
II. Mean (median) bank recovery rate at the trustee's liquidation value estimate[2]			
Bank recovery r_l at the trustee's liquidation value estimate: $r_{bv} = \max[0, \min[(\hat{v}_l - s)/b, 1]]$	0.453 (0.390)	0.738 (0.960)	0.656 (0.768)

III. Expected bank recovery rate using pre-filing outcome probabilities (π)[2]

	Mean	Median	Std. dev.
Expected bank recovery rate r_2 using average bank recovery $\bar{r}_{bn}$: $r_2 = \sum_{n=1}^{3} p_n \bar{r}_{bn}$	0.696	0.700	0.0259
Expected bank recovery rate r_3 using average bank recovery $\bar{r}_{bvn}$ at the trustee's liquidation value estimate $\hat{v}_l$: $r_3 = \sum_{n=1}^{3} p_n \bar{r}_{bvn}$	0.627	0.628	0.0227

[1] See Table 2 for the average bank recovery rate ($\bar{r}_{bvn}$) at the trustee's liquidation value estimate $\hat{v}_l$ across outcomes n. The variables s and b are the face values of the debt senior to the bank and the bank's debt, respectively.

[2] See Table 2 for the average bank recovery rate ($\bar{r}_{bn}$) across states n.

Table 6

Maximum likelihood estimates of the coefficients of a multinomial logit model for the probability of the bank's financing decision in the bankruptcy auction using r_2 as the bank recovery rate definition (the expected bank recovery rate given the average realized bank recovery in each outcome). Sample of 185 firms filing for Swedish auction bankruptcy, 1988-1991.[1]

	Explanatory variables				
Bankruptcy outcome	*constant*	r_2	*distress*	*profmarg*	*size*
I. Coefficient estimates of explanatory variables (p-value)[1]					
Old bank finances winning bid (π_2)	13.539	36.314	-0.170	-0.459	-0.153
	(0.004)	(0.000)	(0.899)	(0.781)	(0.418)
New bank finances winning bid (π_3)	1.986	14.818	0.120	-0.740	0.162
	(0.633)	(0.069)	(0.926)	(0.566)	(0.360)
N=185, Log likelihood=-192.26, LRT=21.57, df=8					
II. Partial derivatives of probabilities with respect to vector of explanatory variables (p-value)[2]					
Piecemeal liquidation (π_1)	-1.571	-5.308	0.003	0.131	-0.003
	(0.072)	(0.006)	(0.990)	(0.623)	(0.918)
Old bank finances winning bid (π_2)	2.707	6.139	-0.051	-0.012	-0.052
	(0.011)	(0.008)	(0.835)	(0.970)	(0.157)
New bank finances winning bid (π_3)	-1.135	-0.832	0.048	-0.118	0.056
	(0.191)	(0.615)	(0.850)	(0.675)	(0.130)

[1] The multinomial logit model has the following general form: $p_{jn} = \exp(x_j' b_n) / \sum_{n=1}^{3} \exp(x_j' b_n)$ where there are K=5 firm-specific characteristics in the (K×1) vector of explanatory variables x_j, β_n is the (5×1) vector of parameters, and there are a total of three possible outcomes. The likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The test is distributed as X^2 with degrees of freedom equal to the number of additional explanatory variables.

[2] The partial derivatives reported in the table are given by $\partial p_n / \partial x_k = p_n (b_{kn} - \sum_{e=1}^{3} b_{ek} p_e)$.

Table 7

Maximum likelihood estimates of the coefficients of a multinomial logit model for the probability of the bank's financing decision in the bankruptcy auction using r_3 as the bank recovery rate variable (the expected recovery rate using the average bank recovery at the trustee's liquidation value estimate). Sample of 185 firms filing for Swedish auction bankruptcy, 1988-1991.

	Explanatory variables				
Bankruptcy outcome	*constant*	r_3	*distress*	*profmarg*	*size*
I. Coefficient estimates of explanatory variables (p-value)[1]					
Old bank finances winning bid (π_2)	17.878	39.084	-0.616	-0.111	-0.189
	(0.002)	(0.000)	(0.647)	(0.945)	(0.312)
New bank finances winning bid (π_3)	2.764	13.817	-0.002	-0.400	0.158
	(0.597)	(0.152)	(0.998)	(0.752)	(0.378)
N=185, Log likelihood=-192.96, LRT=20.15, df=8					
II. Partial derivatives of probabilities with respect to vector of explanatory variables (p-value)[2]					
Piecemeal liquidation (π_1)	-2.104	-5.492	0.062	0.057	0.001
	(0.058)	(0.013)	(0.803)	(0.827)	(0.981)
Old bank finances winning bid (π_2)	3.568	6.885	-0.133	0.023	-0.060
	(0.007)	(0.006)	(0.592)	(0.942)	(0.114)
New bank finances winning bid (π_3)	-1.463	-1.392	0.072	-0.080	0.059
	(0.175)	(0.465)	(0.778)	(0.770)	(0.115)

[1] The multinomial logit model has the following general form: $p_{jn} = \exp(x'_j b_n) / \sum_{n=1}^{3} \exp(x'_j b_n)$ where there are K=5 firm-specific characteristics in the (K×1) vector of explanatory variables x_j, β_n is the (5×1) vector of parameters, and there are a total of three possible outcomes. The likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The test is distributed as X^2 with degrees of freedom equal to the number of additional explanatory variables.

[2] The partial derivatives reported in the table are given by $\partial p_n / \partial x_k = p_n (b_{kn} - \sum_{e=1}^{3} b_{ek} p_e)$.

Table 8

Coefficient in OLS estimations of the auction going-concern premium. The bank recovery rate r_{bv} is calculated at the trustee's liquidation value estimate. Subsample of 173 Swedish firms auctioned in bankruptcy 1988-1991, excluding auction prepacks.[1]

Explanatory variables													
con-stant	*size*	*prof-marg*	r_{bv}	*interest*	*bids*	*distress*	*bcy 1991*	*piece-meal*	*sale-back*	*bankfin*	*Adjus-ted* R^2	*F-value*	*n*
I. Coefficients for OLS regressions of the going concern premium (p-value). Sample of going concern sales and piecemeal liquidations.													
0.382	-0.023	-0.030	-0.742			0.306	-0.072	-0.569			0.122	4.993	173
(0.709)	(0.703)	(0.947)	(0.000)			(0.603)	(0.681)	(0.000)			(df=6)	(0.000)	
0.264	-0.023	-0.037	-0.728			0.493		-0.560			0.126	5.987	173
(0.788)	(0.704)	(0.993)	(0.000)			(0.266)		(0.000)			(df=5)	(0.000)	
0.314	-0.036	-0.081	-0.771			0.521	-0.058	-0.394	0.259		0.136	4.762	168
(0.762)	(0.544)	(0.852)	(0.000)			(0.424)	(0.751)	(0.170)	(0.086)		(df=7)	(0.000)	
0.355	0.026	-0.271	-0.848			0.025		-0.539		0.354	0.192	6.026	127
(0.754)	(0.739)	(0.549)	(0.000)			(0.996)		(0.002)		(0.043)	(df=6)	(0.000)	
0.062	-0.013	-0.263	-0.874			0.033	0.064	-0.363	0.247	0.358	0.196	4.838	126
(0.958)	(0.849)	(0.561)	(0.000)			(0.965)	(0.758)	(0.087)	(0.202)	(0.043)	(df=8)	(0.000)	
II. Coefficients for OLS regressions of the going concern premium (p-value). Sample of going concern sales.													
0.965	-0.062	-0.611	-1.257			-0.319				0.366	0.253	6.540	82
(0.483)	(0.451)	(0.540)	(0.000)			(0.593)				(0.034)	(df=5)	(0.000)	
0.608	-0.054	-0.617	-1.279			-0.155			0.192	0.376	0.273	6.073	81
(0.669)	(0.517)	(0.533)	(0.000)			(0.797)			(0.290)	(0.029)	(df=6)	(0.000)	
1.988	-0.134	-1.059	-1.316		-0.018	-0.371	0.051			0.457	0.242	3.322	51
(0.275)	(0.201)	(0.446)	(0.001)		(0.721)	(0.765)	(0.872)			(0.067)	(df=7)	(0.006)	
1.377	-0.112	-1.013	-1.326		0.027	-0.222			0.291	0.479	0.303	4.098	50
(0.451)	(0.283)	(0.450)	(0.000)		(0.578)	(0.812)			(0.226)	(0.049)	(df=7)	(0.002)	
2.295	-0.139	-1.270	-1.304	-0.052	0.058	-0.696				0.521	0.258	3.535	51
(0.194)	(0.179)	(0.362)	(0.000)	(0.322)	(0.368)	(0.465)				(0.040)	(df=7)	(0.004)	

[1] The auction premium is defined as $\ln\left(p / \hat{v}_l^a\right)$, where p is the price received in the auction and $\hat{v}_l^a$ is the trustee's liquidation value estimate for the assets sold in the going-concern auction. The bank recovery rate at $\hat{v}_l^a$ is defined as $r_{bv} \equiv (\hat{v}_l^a - s) / b$, where *s* and *b* are the face values of the debt senior to the bank and the bank's debt, respectively.

Table 9

Coefficients in OLS estimations of the auction going-concern premium. The bank recovery rate r_{bv} is calculated at the trustee's liquidation value estimate. Subsample of 173 Swedish firms auctioned in bankruptcy 1988-1991, excluding auction prepacks.[1]

Explanatory variables													
constant	*size*	*profmarg*	r_{bv}	*bids*	*distress*	*bcy 1991*	*piecemeal*	*saleback*	*bankfin*	*outsider*	*Adjusted* R^2	*F-value*	*n*
I. Coefficients for OLS regressions of the going concern premium (p-value). Sample of going concern sales and piecemeal liquidations.													
-0.462	0.003	-0.220	-0.798		0.268			0.340	0.418	-0.135	0.184	5.061	126
(0.687)	(0.959)	(0.628)	(0.000)		(0.613)			(0.119)	(0.019)	(0.558)	(df=7)	(0.000)	
0.326	-0.022	-0.268	-0.843		0.026		-0.500		0.342	-0.058	0.186	5.136	127
(0.775)	(0.767)	(0.556)	(0.000)		(0.966)		(0.025)		(0.059)	(0.782)	(df=7)	(0.000)	
0.318	-0.021	-0.269	-0.841		0.042	0.001	-0.500		0.342	-0.058	0.179	4.457	127
(0.786)	(0.767)	(0.557)	(0.000)		(0.956)	(0.971)	(0.026)		(0.060)	(0.785)	(df=8)	(0.000)	
0.251	-0.021	-0.078	-0.741		0.583		-0.413			-0.223	0.132	5.380	173
(0.797)	(0.721)	(.859)	(0.000)		(0.191)		(0.018)			(0.145)	(df=6)	(0.000)	
II. Coefficients for OLS regressions of the going concern premium (p-value). Sample of going concern sales.													
0.997	-0.064	-.588	-1.263		-.359				.379	0.066	0.243	5.398	82
(0.473)	(.440)	(.560)	(0.000)		(.561)				(.035)	(.781)	(df=6)	(0.000)	
2.083	-0.135	-0.993	-1.368	0.014	-.564				0.483	0.123	0.244	3.354	51
(0.238)	(0.195)	(0.476)	(0.000)	(.781)	(.554)				(0.056)	(0.678)	(df=7)	(0.006)	
0.645	0.058	0.528	-0.974	0.021	1.070					-0.222	0.157	3.510	81
(0.658)	(0.513)	(0.656)	(0.000)	(0.376)	(0.133)					(0.307)	(df=6)	(0.004)	

[1] The auction premium is defined as $\ln\left(p / \hat{v}_l^a\right)$, where p is the price received in the auction and $\hat{v}_l^a$ is the trustee's liquidation value estimate for the assets sold in the going-concern auction. The bank recovery rate at the trustee's liquidation value estimate, $\hat{v}_l^a$, is defined as $r_{bv} \equiv (\hat{v}_l^a - s)/b$, where *s* and *b* are the face values of the debt senior to the bank and the bank's debt, respectively.

Figure 1

The reservation price p_m* which maximizes expected revenue for a monopolist seller of the bankrupt firm in an open, ascending auction with zero bidding costs. Bidders' private valuations v have distribution and density functions G(v) and g(v), respectively, and the seller owns α=100% of the firm. The seller's opportunity cost is v_m.

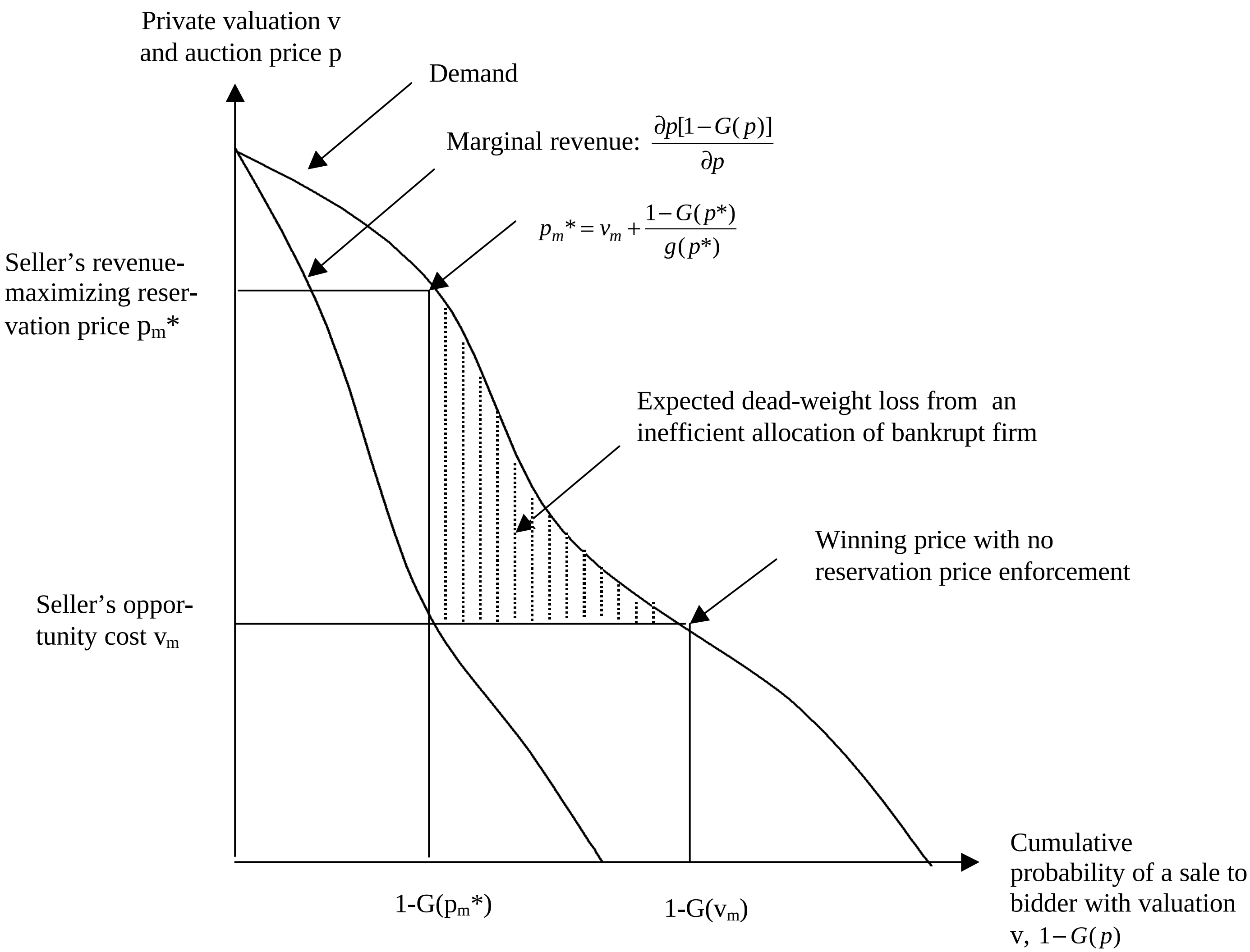


Figure 2

The efficiency of outcomes from overbidding p* in the bankruptcy auction by the coalition of the bank and bidder 1. It is assumed that p*<s+b, where b and s are the face values of the bank's debt and debt senior to the bank's claim, respectively. The private valuations of bidders 1 and 2 are denoted v_1 and v_2, respectively.

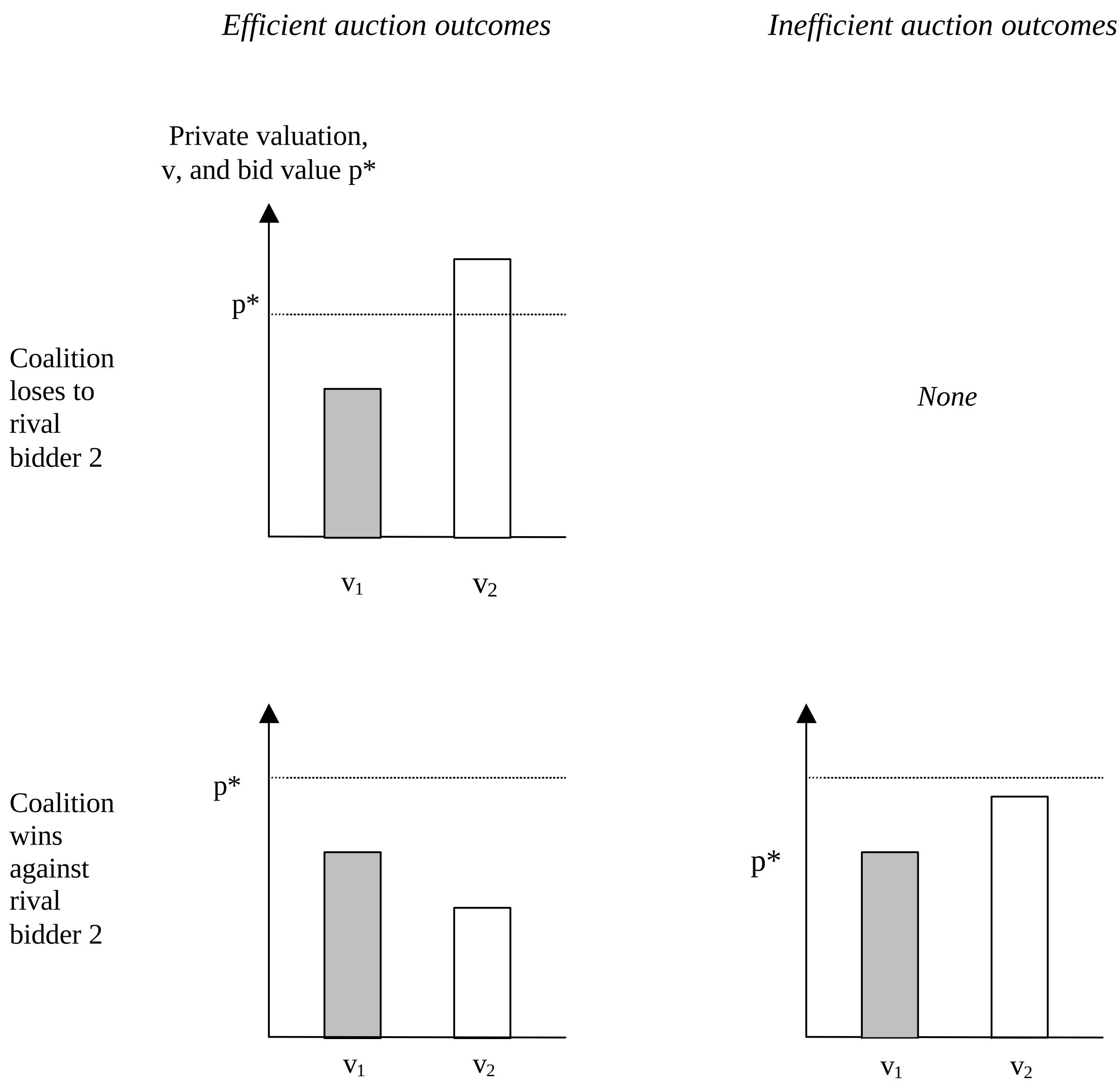
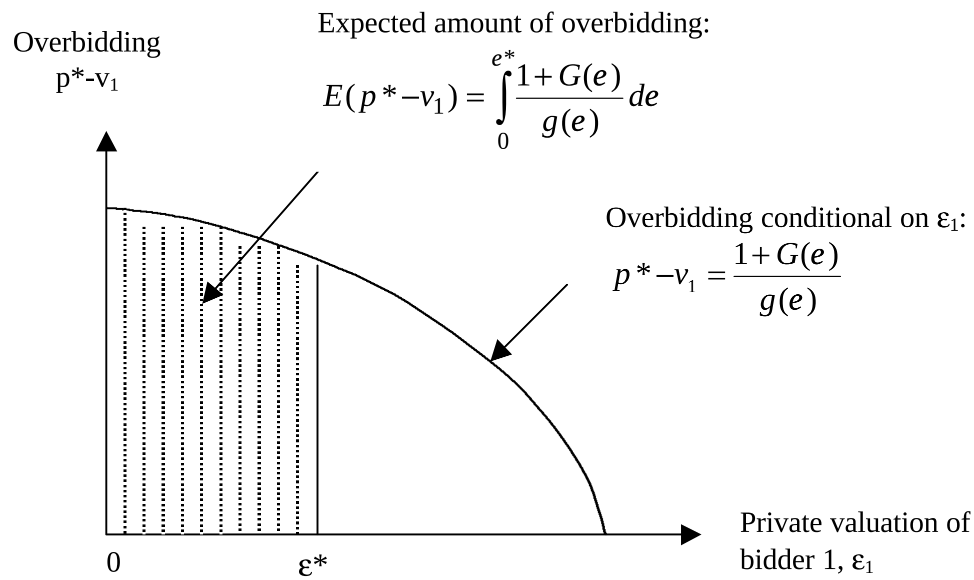


Figure 3

Expected overbidding p^*-v_1 as a function of truncated private valuation $\varepsilon^*=\max[s+b-v_l,0]$, where b and s are the face values of bank debt and debt senior to the bank, respectively, and v_l is the (common) piecemeal liquidation value at the start of the auction.



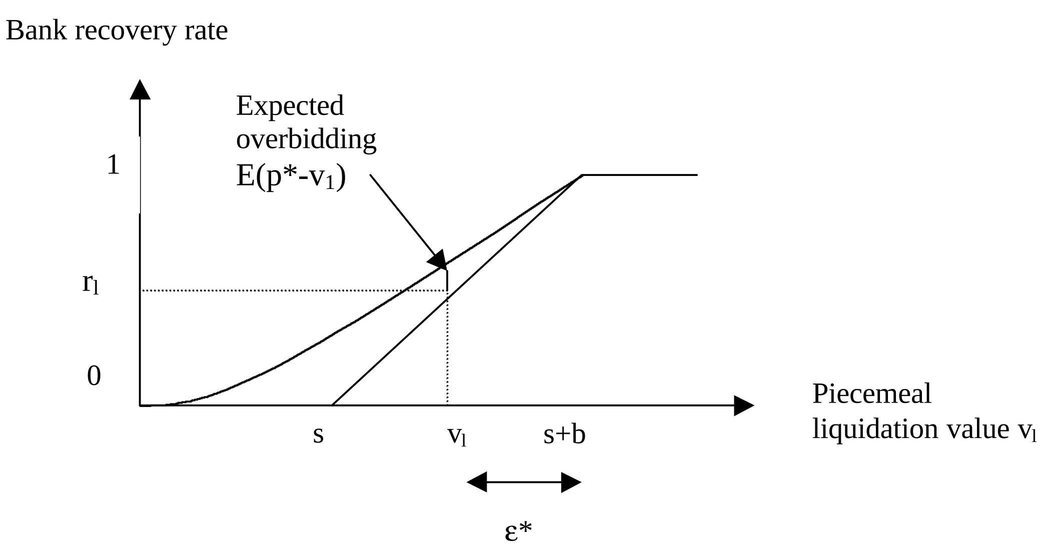


Figure 4

Key outcomes in Swedish bankruptcy.

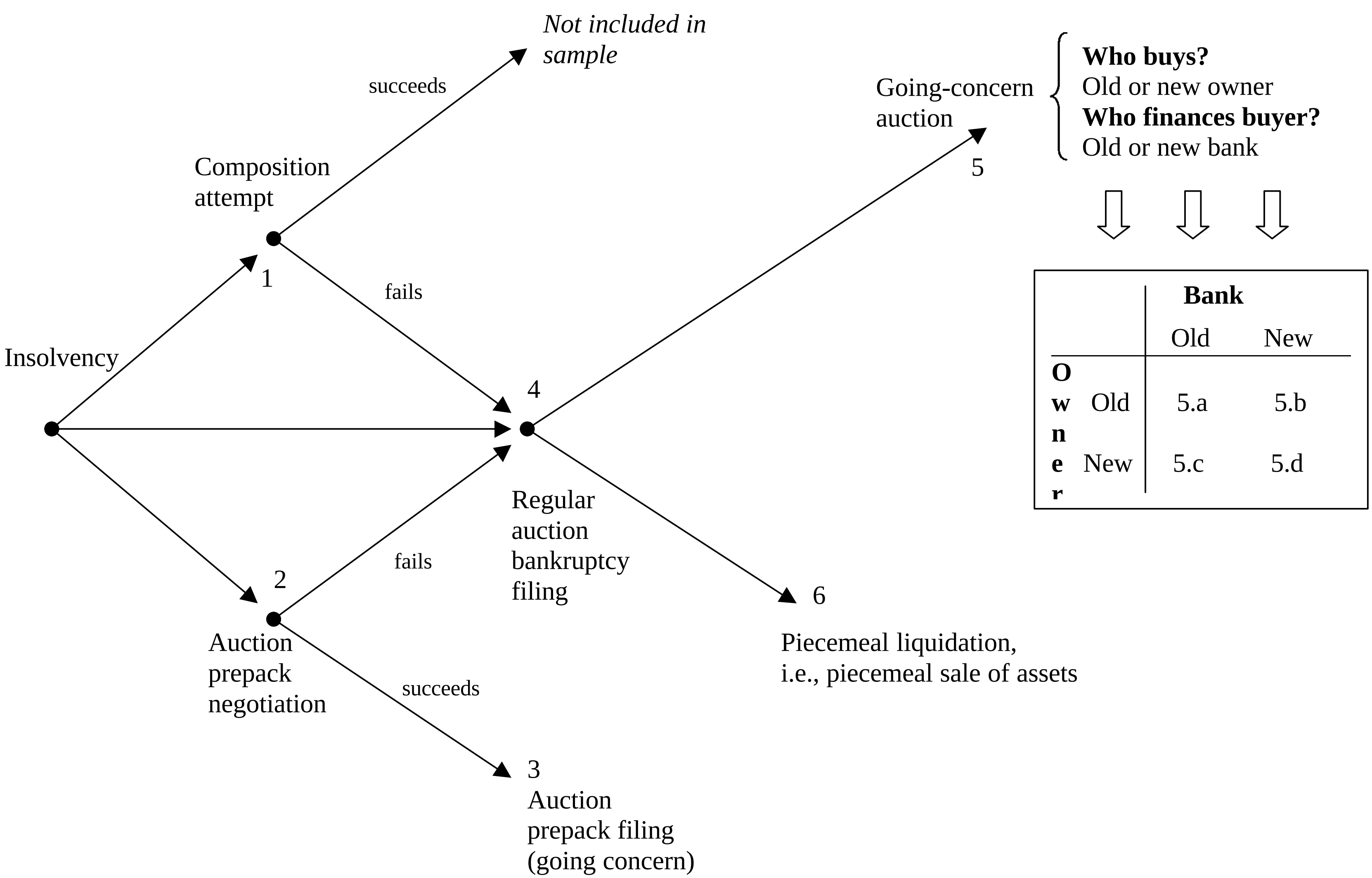


Figure 5

Frequency distribution for the number of "interested bidders" in Swedish bankruptcy auctions. Sample of 94 going concern sales, 1988-1992

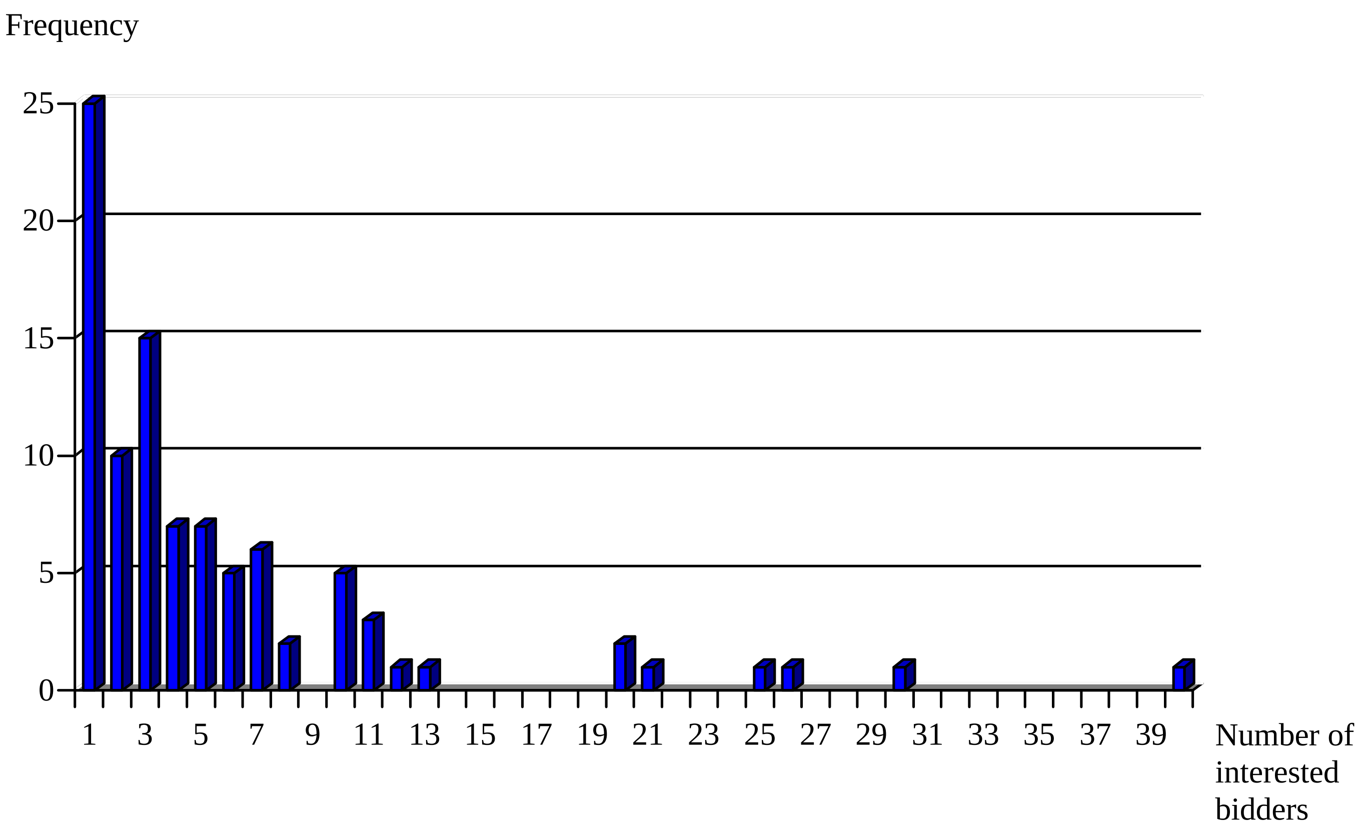


Figure 6

Frequency distribution for the number of actual bids in Swedish bankruptcy auctions. Sample of 89 going concern sales, 1988-1992.