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We present unique empirical tests for auction overbidding using data from Sweden's auction bankruptcy system. The main creditor (a bank) can neither bid in the auction nor refuse to sell in order to support a minimum price. However, we argue that the bank may increase its expected revenue by financing a bidder in return for a joint bid strategy, and we show that the optimal coalition bid exceeds the bidder's private valuation (overbidding) by an amount that is increasing in the bank's ex ante debt impairment. We find that bank–bidder financing arrangements are common, and our cross-sectional regressions show that winning bids are increasing in the bank-debt impairment as predicted. While, in theory, overbidding may result in the coalition winning against a more efficient rival bidder, our evidence on post-bankruptcy operating performance fails to support such allocative inefficiency effects. We also find that restructurings by bank-financed bidders are relatively risky as they have greater bankruptcy refiling rates, irrespective of the coalition's overbidding incentive.

Keywords

bankruptcy, auction, overbidding, creditor financing, allocative efficiency, going-concern sale, piecemeal liquidation, operating performance

Disciplines

Bankruptcy Law | Finance | Finance and Financial Management

Comments

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Creditor financing and overbidding in bankruptcy auctions: Theory and tests*

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such allocative inefficiency effects. We also find that restructurings by bank-financed bidders are relatively risky as they have greater bankruptcy refiling rates, irrespective of the coalition's overbidding incentive.

1 Introduction

In Sweden, a firm filing for bankruptcy is turned over to a court-appointed trustee who puts the firm up for sale in an auction. This mandatory auction system has an attractive simplicity. All debt claims are stayed during the auction period and the bids determine whether the firm will be continued as a going concern or liquidated piecemeal. Payment must be in cash, allowing the auction proceeds to be distributed to creditors strictly according to absolute priority. Moreover, the auctions are quick (lasting an average of two months) and relatively cost-efficient, and as much as three-quarters of the filing firms survive the auction as a going concern (Thorburn, 2000). A going-concern sale takes place by merging the assets and operations of the auctioned firm into the bidder firm, or into an empty corporate shell—much like a leveraged buyout transaction.

There is an ongoing debate over the relative efficiency of auction bankruptcy versus Chapter 11 in the U.S., where firms are reorganized in bankruptcy. Proponents of a more market-oriented auction system point to costs associated with conflicts of interests and excessive continuation of operations due to managerial control over the restructuring process in Chapter 11.[1] Perhaps as a result, there is a trend towards increased use of market-based mechanisms in the U.S., as evidenced by prepackaged bankruptcies (Betker, 1995; **?**), participation by distressed investors (Hotchkiss and Mooradian, 1997), and sales in Chapter 11 (Hotchkiss and Mooradian, 1998; Maksimovic and Phillips, 1998). In fact, Baird and Rasmussen (2003) report that more than three-quarters of all large Chapter 11 cases resolved in 2002 involved the sale of company assets or a prepackaged bankruptcy procedure.

On the other hand, proponents of Chapter 11 argue that the time pressure of an auction system is costly as it possibly causes excessive liquidation of economically viable firms when potential bidders in the auction are themselves financially constrained. However, **?** fail to find auction fire-sale discounts in going-concern sales, and the three-quarters survival rate reported for the Swedish auction system is similar to that of Chapter 11.[2] Also, in Eckbo and Thorburn (2003) we show that firms purchased as going concerns in the auction tend to perform at par with non-bankrupt

[1]See, e.g., Baird (1986), Bebchuk (1988), Jensen (1989), Aghion, Hart, and Moore (1992), Bebchuk and Chang (1992), Bradley and Rosenzweig (1992), and Baird (1993). Hotchkiss (1995) finds that firms emerging from Chapter 11 tend to underperform their industry rivals which is consistent with excessive continuation.

[2]See, e.g., White (1984), Franks and Torous (1989), Weiss (1990), LoPucki and Whitford (1993), and Hotchkiss, John, Mooradian, and Thorburn (2008) for a review.

industry rivals.

In this paper, we study an empirical issue of importance for the workings of the auction system: the incentives and opportunities of the bankrupt firm's major creditor to influence the auction outcome. We show that creditor incentives have the potential for affecting both the liquidity and allocative efficiency of bankruptcy auctions. Our empirical evidence is based on 260 private Swedish firms auctioned in bankruptcy. The average firm has $5 million in sales and assets of $2 million ($8 million and $4 million, respectively, in 2007 dollars), and it has an average of forty-five employees. This small-firm evidence is of interest to the U.S. debate as a majority of Chapter 11 filings are also by small private firms: Chang and Schoar (2007) report average sales of $2 million and twenty-two employees in a large and representative sample of Chapter 11 filings between 1989 and 2003. Bris, Welch, and Zhu (2006) report that the median firm filing for Chapter 11 has assets of $1 million.

In our sample, as is common for small firms, the bankrupt firm's secured creditor is a bank. Upon filing, whenever the bank's debt claim is impaired, the bank becomes the firm's residual claimant and therefore effectively the seller in the auction. Auction rules and banking regulations prevent the bank from openly enforcing a seller reserve price (it can neither bid directly nor refuse to sell). However, we observe that the bank often finances the winning bidder in the auction. We postulate that the bank uses this bid financing as a vehicle for engineering a (bank-bidder) coalition to get around the auction bidding constraint. Under certain conditions, the coalition optimally overbids, i.e., bids more than the private valuation of the bank's coalition partner. We show that the optimal coalition bid mimics the sales price of a monopolist seller when the bank's debt is greatly impaired. In this situation, the bank effectively enforces a reserve price and raises its expected debt recovery. This also raises the possibility that the bankrupt firm ends up being acquired by a relatively inefficient bidder. Allocative inefficiency occurs when the bank-bidder coalition wins against a rival bidder that has a higher private valuation of the target.[3]

Our empirical analysis addresses both the overbidding- and efficiency aspects of the auctions. First, we present a unique test for the existence of overbidding based directly on auction premiums.

[3]Issues of auction efficiency also arise in the context of fire-sales (Shleifer and Vishny, 1992; **?**), the choice of auction versus renegotiation (Hansen and Thomas, 1998; Hotchkiss and Mooradian, 2003), the payment method (Aghion, Hart, and Moore, 1992; Rhodes-Kropf and Viswanathan, 2000), and managerial investment in human capital (Berkovitch, Israel, and Zender, 1997). In Berkovitch, Israel, and Zender (1997), participation in the bankruptcy auction by a relatively informed creditor produces under-investment in managerial human capital ex ante. Our argument below does not rely on the bank having an informational advantage over other bidders.

To characterize the test approach, it is instructive to think of the bankruptcy event as creating an instant "bank toehold" equal to one (one hundred percent bank ownership of the auctioned firm) when bank debt is impaired. As with toehold bidding in general, toeholds raise the bidder's reserve price above and beyond its private valuation—referred to as "overbidding" (Burkart, 1995; Bulow, Huang, and Klemperer, 1999). In our bankruptcy auction setting, bank-bidder coalition overbidding increases the expected auction revenue flowing to the bank.[4] Hotchkiss and Mooradian (2003) also examine creditor overbidding incentives, but in the context of voluntary sales in Chapter 11 of the U.S. bankruptcy code.

Importantly, the coalition optimally overbids *only* if the bank's debt claim is impaired at the outset of the auction (further overbidding just benefits junior creditors). It is this cross-sectional restriction that makes overbidding testable in our setting. This restriction does not exist for takeovers outside of bankruptcy. Extant empirical evidence on toehold-induced overbidding is therefore indirect. For example, theory implies that overbidding increases the probability of winning, which is supported by studies of corporate takeover bids with equity toeholds (Betton and Eckbo, 2000).

Our tests require a measure of the degree of bank-debt impairment at the beginning of the auction, capturing the bank's overbidding incentive. We use the ex ante *liquidation recovery rate*, defined as the firm's expected piecemeal liquidation value scaled by the face value of the bank's debt. At the beginning of every auction, the bankruptcy trustee publishes an industry estimate of the piecemeal liquidation value, which we use directly. Bidders appear to rely on this estimate as well: when the auction does lead to piecemeal liquidation, the average price paid by the winning bidder is close to (on average eight percent above) the trustee's estimate. In contrast, when the bankrupt firm is purchased as a going concern, the average auction premium more than doubles the trustee's piecemeal liquidation value estimate.

In theory, the greater the liquidation recovery rate, the lower is the incentive to overbid and, in turn, the lower is the expected premium paid by the winning bidder. We find that when the firm is sold as a going concern, auction premiums are decreasing in the liquidation recovery rate, as predicted. Equally important, there is no evidence of overbidding in auction premiums in subsamples where the theory implies *zero* overbidding incentive. There are two such subsamples,

[4] Burkart (1995) alludes to the analogy between an impaired debt claim and a toehold: "When a bankrupt firm's assets are auctioned off, the firm's creditors are in a similar position to that of a large shareholder" (p. 1506).

representing forty percent of the total sample. The first subsample consists of auctions that result in a going-concern sale, but where the bank's debt is *not* impaired at the ex ante liquidation value. In this case, the bank has no incentive to push for a coalition bidding strategy since any revenue increase flows to junior creditors. Second, overbidding for targets that are expected to be liquidated piecemeal is suboptimal because these targets have only negligible going-concern value. When no bidder values the target as a going concern, there are no rents to be extracted from rival bidders through overbidding. We detect no evidence of overbidding in either subsample. Overall, our test results provide surprisingly robust support for our coalition overbidding theory.

Our main overbidding theory presumes that that bank managers act in the interest of the bank's shareholders by attempting to maximize auction revenue. We also consider an alternative coalition bidding strategy, dubbed "debt rollover". Here, entrenched bank managers use the first-price auction to roll over impaired bank debt at face value in order to hide non-performing loans from their superiors. Under the rollover hypothesis, the coalition's bid equals the face value of the bank debt (plus any debt senior to the bank), effectively establishing a price floor in the auction. While the rollover hypothesis also implies overbidding, it predicts an auction revenue that is approximately equal to the face value of the bank's debt when the coalition wins. The data rejects this prediction.

Overbidding results in allocative inefficiency whenever the bank-bidder coalition wins against a higher-valuation bidder. Thus, a second objective of our empirical analysis is to shed light on whether the auction system tends to produce inefficient outcomes due to overbidding. Previous work shows that firms restructured under Swedish bankruptcy auctions typically perform at par with non-bankrupt industry rivals (Eckbo and Thorburn, 2003). However, the previous evidence does not condition on bank financing and overbidding incentives. The intersection of bank financing of the winning bidder and high overbidding incentives is the ideal place to look for ex post allocative inefficiency. We find post-bankruptcy operating performance to be at par with industry rivals for these subgroups of auctions as well. If anything, the operating performance is higher in the subsample where the bank-bidder coalition wins and overbidding incentives are high ex ante.

Finally, we show that the probability of bankruptcy refiling over the two years following the auction is significantly greater when the bank finances the winning bidder. This refiling probability is, however, independent of overbidding incentives and therefore cannot be attributed to inefficiencies in the auction per se. A consistent interpretation is that banks tend to finance relatively high-risk restructuring prospects. In sum, bank-financing of bidders increases auction liquidity, and seem to result in overbidding without significantly distorting the restructuring process.

The paper is organized as follows. Section 2 develops the coalition-bidding model and the model's central empirical implications. Section 3 describes the data selection and sample characteristics. Section 4 performs the main cross-sectional tests for overbidding. Section 5 shows post-bankruptcy performance statistics, while Section 6 concludes the paper.

2 Bank-bidder coalition overbidding

In this section, we develop the overbidding hypothesis, its key empirical prediction (Proposition 1), and we comment on factors that may attenuate overbidding incentives in our Swedish setting.

2.1 The auction setting

The Swedish bankruptcy code mandates an open bid first-price auction. As is common in the toehold literature, we use the sealed-bid second-price analogy for analytical tractability.[5] We assume the existence of two bidders who are risk neutral and have unaffiliated private valuations of the target firm. Bidder i's private valuation of the auctioned firm's asset is denoted $v_i \in [0, 1]$ ($i = 1, 2$). Private valuations are iid with distribution and density functions $G(v)$ and $g(v)$, respectively. The bids determine whether the firm's assets will be purchased individually (piecemeal liquidation) or at the higher price required to continue the target as a going concern.

Denote the piecemeal liquidation value by l, and the going-concern premium by p, so that the total price paid by the winning bidder is $p + l$. The trustee provides bidders with a professional industry estimate of l at the start of the auction. Our auction premium data below suggests that bidders tend to treat l as a minimum price in the auction: when the auction results in piecemeal liquidation, the price paid is on average 8% higher than the estimate l. In contrast, when the auction outcome is a sale of the target as a going concern, the price paid averages 2.25 times l, or a going-concern premium of $p = 125\%$. For simplicity, we treat l as a known constant, and derive

[5] With zero bidding costs, the sealed-bid second-price auction is revenue-equivalent to the open first-price auction and it produces identical asset allocation (Klemperer, 2000; Dasgupta and Hansen, 2007).

optimal bids b_i determining the auction premium p. We reintroduce l in Section 2.4 when deriving testable restrictions of the theory.

2.2 The coalition's optimal bid

While the bank cannot bid directly in the auction, there are no regulatory restrictions on the bank's ability to issue debt to a bidder. Suppose the bank approaches a randomly selected bidder (henceforth bidder 1) and offers to finance the acquisition should the bidder win the auction. Bidding alone, the optimal bid of bidder 1 is $b_1 = v_1$.[6] Assuming $l = 0$, the following represents an incentive-compatible coalition bid strategy:

Proposition 1 (optimal coalition bid strategy): *Let $l = 0$ and suppose the bank is the bankrupt firm's only senior creditor, holding a debt claim with face value f. The following represents a revenue-maximizing coalition bid strategy:*

$$b_c = \begin{cases} v_1 + h(b_c) & if \quad v_1 \leq f - h(b_c) & (\textit{unconstrained overbidding}) \\ f & if \quad f - h(b_c) < v_1 < f & (\textit{constrained overbidding}) \\ v_1 & if \quad v_1 \geq f, & (\textit{no overbidding}) \end{cases} \tag{1}$$

where $h(b_c) \equiv [1 - G(b_c)]/g(b_c)$ is the inverse of the hazard function at b_c.

Proof: Starting with the coalition bid under unconstrained overbidding, the expected revenue π_c to the bank-bidder coalition from unconstrained bidding is

$$\pi_c = \int_{b_c}^{1} b_c g(v_2) dv_2 + \int_{0}^{b_c} v_1 g(v_2) dv_2 = b_c[1 - G(b_c)] + v_1 G(b_c), \tag{2}$$

where the first term on the right-hand-side is the expected revenue if the coalition loses to bidder 2, and the second term is the net payoff of $(v_1 - b_2) + b_2 = v_1$ times the probability of winning, $G(b_c)$. The first-order condition with respect to b_c is

$$\frac{\partial \pi_c}{\partial b_c} = 1 - G(b_c) - b_c g(b_c) + v_1 g(b_c) = 0, \tag{3}$$

[6]Dropping out of the auction when $b_1 < v_1$ means foregoing a positive expected profit from winning at a price less than v_1. Moreover, a bid of $b_1 > v_1$ implies a negative expected profit conditional on winning.

which yields the optimal coalition bid $b_c = v_1 + h(b_c)$.[7]

Turning to the constrained overbidding price in Eq. (1), this bid reflects the effect of the bank-debt face value f. As the senior claimant, the bank has no incentive to help generate an auction revenue that exceeds f, as every dollar of additional overbidding is transferred directly to junior creditors. Thus, when $f - h(b_c) < v_1 < f$, the coalition bids $b_c = f$. Finally, when $v_1 \geq f$, the creditor toehold is effectively zero, and the coalition optimally bids bidder 1's private valuation, $b_c = v_1$. ■

By raising the price in the auction, overbidding produces a wealth transfer from bidder 2 to the coalition when $v_2 > b_c > v_1$. The optimal coalition bid strategy is illustrated in Figure 1 for the case of the uniform distribution, $v_i \sim U[0, 1]$. The horizontal axis plots v_1 and the bold-faced line shows the coalition bid b_c. The first segment of the bold-faced line is the unconstrained overbidding price, $b_c = v_1 + h(b_c) = (v_1 + 1)/2$. The second (horizontal) segment is the constrained overbidding price, $b_c = f$, which occurs when $f - h(b_c) < v_1 < f$. The segment starts when v_1 is such that the unconstrained bid price equals the face value f. The third segment starts when $v_1 > f$. Here, the bank's debt is fully paid off without overbidding, so that $b_c = v_1$.

2.3 Incentive compatibility and bid delegation

Coalition overbidding is ex post costly for bidder 1 unless the highest-valuation bidder wins. Since bidder 1 is responsible for paying the bid, the coalition agreement must include a compensating transfer to bidder 1. Proposition 2 holds that there exists a positive transfer from the bank to bidder 1, which satisfies the participation constraint by both coalition parties:

> **Proposition 2 (incentive compatibility):** *Let c denote the cost to bidder 1 of participating in the coalition, and t the bank's net revenue from coalition bidding (net of the bank's revenue without coalition bidding). Conditional on the optimal coalition bid strategy b_c in Proposition 1, $E(t) > E(c)$ so coalition formation is incentive compatible.*

[7] To ensure uniqueness, G must be twice continuously differentiable and satisfy the monotonicity condition $\partial h^{-1}(v)/\partial v \geq 0$.

Proof: We have that

$$c = \begin{cases} 0 & if \quad v_2 \leq v_1 \leq b_c \quad (coalition\ wins\ and\ pays\ v_2 \leq v_1) \\ v_2 - v_1 & if \quad v_1 < v_2 \leq b_c \quad (coalition\ wins\ and\ pays\ v_2 > v_1) \\ 0 & if \quad v_1 \leq b_c < v_2 \quad (coalition\ loses) \end{cases} \tag{4}$$

The expected overbidding cost to bidder 1 is

$$E(c) = \int_{v_1}^{b_c} (v_2 - v_1) g(v_2) dv_2. \tag{5}$$

The bank's net revenue t is given by

$$t = \begin{cases} 0 & if \quad v_2 \leq v_1 \leq b_c \quad (coalition\ wins\ and\ pays\ v_2 \leq v_1) \\ v_2 - v_1 & if \quad v_1 < v_2 \leq b_c \quad (coalition\ wins\ and\ pays\ v_2 > v_1) \\ b_c - v_1 & if \quad v_1 \leq b_c < v_2 \quad (coalition\ loses) \end{cases} \tag{6}$$

The expected net revenue is

$$E(t) = \int_{v_1}^{b_c} (v_2 - v_1) g(v_2) dv_2 + (b_c - v_1)(1 - G(b_c)) = E(c) + (b_c - v_1)(1 - G(b_c)). \tag{7}$$

Since, with overbidding, $b_c > v_1$, it follows that $E(t) > E(c)$ and the bank's expected net revenue is sufficient to cover the coalition partner's expected overbidding cost. ■

Figure 3 illustrates the gains and losses from coalition bidding for the uniform case. The vertical axis is bidder 2's valuation v_2 and the horizontal axis is $G(v_2)$. Area A equals bidder 1's expected profit from bidding alone. Area C is the bank's expected revenue without coalition formation. Area E is the expected cost to bidder 1 from overbidding (the minimum transfer), while the bank's expected net revenue $E(t)$ equals area $D+E$. Area D is the expected wealth transfer from bidder 2 resulting from coalition overbidding and thus the coalition's net surplus (which motivates coalition formation).

To induce participation by bidder 1 in the coalition, the coalition agreement may stipulate a transfer of an amount at least equal to $E(c)$ (area E) ex ante (at the beginning of the auction). Alternatively, the agreement may arrange for at least $v_2 - v_1$ to be paid to bidder 1 conditional on winning against a less efficient bidder ($v_1 < v_2$). Since the loan takes effect only if the coalition wins, a simple way to effectuate this ex post transfer is for the bank to reduce the interest on the loan.

After establishing the optimal coalition bid strategy and a compensating transfer to bidder 1, the bank may fully delegate bidding to its coalition partner. This follows because the transfer to bidder 1 increases its private valuation of the auctioned firm. Since it is a dominant strategy for bidder 1 to bid its private valuation (when bidding alone), the transfer causes bidder 1 to voluntarily raise its bid. Thus, the transfer plays the dual role of inducing bidder 1 to participate and to delegate the coalition bidding strategy.

2.4 The bank as monopolist seller

As mentioned in the introduction, although the bank is effectively a monopolist seller in the auction, regulatory constraints prevent it from enforcing a seller reserve price. By forming a coalition, however, the bank gets around the regulatory constraint. To see why, let b_m denote the price charged by a monopolist seller in a take-it-or-leave-it offer to sell the bankrupt firm, and suppose the monopolist seller's alternative use is worth v_1, so the expected opportunity cost of selling is $v_1[1 - G(b_m)]$. Moreover, the expected sales revenue is $b_m[1 - G(b_m)]$. Equating the expected marginal revenue $[1-G(b_m)-b_m g(b_m)]$ with expected marginal cost $[-v_1 g(b_m)]$ yields a monopolist selling price of $b_m = v_1 + h(b_m)$ which is identical to the unconstrained coalition bid in Proposition 1. In other words, the coalition bid b_c allows the bank to achieve its expected revenue objective despite the institutional restriction preventing the bank from directly enforcing its seller reserve price.

2.5 Factors attenuating overbidding

A number of factors may work to attenuate the degree of coalition overbidding. If the bank is not the sole member of its creditor class, its toehold is reduced from a value of one to the proportion $\theta < 1$ of the creditor class owned by the bank (Hotchkiss and Mooradian, 2003). This scales down the overbidding amount, as terms involving $h(b_c)$ in Eq. (1) are replaced by $\theta h(b_c)$.[8] Empirically, the case with $\theta < 1$ is irrelevant for our Swedish data where the bank is always the sole member of its debt class.

Second, in small- and medium-sized Swedish companies, it is common for the bank to demand a personal loan guarantee from the owner-manager. Such loan guarantee effectively makes the owner a residual claimant in the auction—with a concomitant reduction in the impairment of the bank's debt. The loan guarantee provides the old owner with an incentive to overbid even without formation of a coalition. In a saleback coalition, where the old owner is attempting to buy back the firm, the existence of a personal guarantee eliminates the need for a transfer to induce coalition overbidding. We address this possibility by treating salebacks as a separate category in parts of the empirical analysis.

Third, our analysis presumes that bidder 1, following coalition formation, fully reveals v_1 to the bank. Full revelation is a standard assumption in the literature on reorganization of financially distressed firms.[9] It can be shown, however, that the transfer necessary to induce bidder 1 to participate in the coalition is decreasing in v_1.[10] As a result, the bidder may have an incentive to understate v_1 in order to increase the transfer under the coalition agreement. In this case, bidder 1 seeks to capture informational rents which reduces the bank's profit and the overall incentive to form a coalition, possibly to the point where coalition formation is no longer incentive compatible for the bank.

Again, with symmetric information, the bank's coalition profit exceeds the minimum transfer

[8] As in Burkart (1995), the coalition's maximization problem (unconstrained by f) is now

$$\text{Max}_{\text{b}_\text{c}} \quad \pi_c = \int_0^{b_c} [v_1 - (1-\theta)v_2]g(v_2)dv_2 + \theta b_c(1 - G(b_c)).$$

The first term is the expected profit if the coalition wins and acquires the remaining $1-\theta$ portion of the firm at a price of v_2. The second term is the expected profit when bidder 2 wins and purchases the coalition's toehold at the price b_c. The first-order condition is $(v_1 - (1-\theta)b_c)g(b_c) + \theta[1 - G(b_c)] - \theta b_c g(b_c) = 0$. Rearranging yields an optimal (unconstrained) coalition bid of $b_c = v_1 + \theta h(b_c)$.

[9] See, e.g. Bulow and Shoven (1978), Brown (1989), Gertner and Scharfstein (1991), Strömberg (2000), Hotchkiss and Mooradian (2003).

[10] The partial derivatives with respect to v_1 of the participation constraints for the bidder (Eq. 5) and the bank (Eq. 7) are, respectively,

$$\begin{aligned} \frac{\partial E(c)}{\partial v_1} &= (b_c - v_1)g(b_c)\frac{\partial b_c}{\partial v_1} - [G(b_c) - G(v_1)] \leq 0 \\ \frac{\partial E(t)}{\partial v_1} &= [1 - G(b_c)]\frac{\partial b_c}{\partial v_1} - [1 - G(v_1)] \leq 0 \end{aligned}$$

given the monotonicity condition $\partial h^{-1}(v)/\partial v \geq 0$.

necessary to induce participation by bidder 1. The bank has an incentive to allocate some or all of this excess profits towards reducing the information advantage of bidder 1, e.g. by purchasing an audit. Alternatively, the bank may approach a bidder with whom it has a prior banking relationship. Thus, the degree of information asymmetry between the bank and its coalition partner may well be limited in practice.

2.6 A testable restriction on overbidding

We now bring the piecemeal liquidation value l back into the analysis. Let $r \equiv l/f \in [0,1]$ denote the bank's recovery rate at the piecemeal liquidation value. Thus, r is the fraction of the face value expected to be recovered by the bank if the firm is liquidated piecemeal.

> **Proposition 3 (expected going-concern premium):** *Given the optimal coalition bid b_c in Eq. (1), the expected going-concern premium $E(p)$ paid by the winner in the auction decreases as the bank's liquidation recovery rate r increases.*

Proof: The proposition is that r affects $E(p)$ via its impact on the expected coalition bid $E(b_c)$ so that

$$\frac{\partial E(p)}{\partial r} = \frac{\partial E(p)}{\partial E(b_c)} \frac{\partial E(b_c)}{\partial r} < 0 \tag{8}$$

We proceed by showing that $\partial E(p)/\partial E(b_c) > 0$ and that that $\partial E(b_c)/\partial r < 0$. Notice first that coalition overbidding increases the expected premium paid by the winning bidder: if the coalition wins, the expected premium is $E(v_2|b_c) > E(v_2|v_1)$, and if it loses, bidder 2 pays $b_c > v_1$. In other words, $\partial E(p)/\partial E(b_c) > 0$. Second, using the integral limits defined in Eq. (1), we have that

$$E(b_c) = \int_0^{f-h(b_c)} [v_1 + h(b_c)]g(v_1)dv_1 + \int_{f-h(b_c)}^{f} fg(v_1)dv_1 + \int_f^1 v_1 g(v_1)dv_1 \tag{9}$$

Replacing f with $f(r) \equiv l/r$, and defining $k(r) \equiv f(r) - h(b_c)$:

$$E(b_c) = \int_0^{k(r)} [v_1 + h(b_c)]g(v_1)dv_1 + f(r)[G(f(r)) - G(k(r))] + \int_{f(r)}^1 v_1 g(v_1)dv_1 \tag{10}$$

The first-order condition with respect to r is

$$\frac{\partial E(b_c)}{\partial r} = [k(r) + h(b_c)]g(k(r))k'(r) + f'(r)[G(f(r)) - G(k(r))] + f(r)[g(f(r))f'(r)) - g(k(r))k'(r)] - f(r)g(f(r))f'(r) \quad (11)$$

Since $f'(r) = k'(r) = -l/r^2 < 0$ and $f(r) > k(r)$:

$$\frac{\partial E(b_c)}{\partial r} = f'(r)[G(f(r)) - G(k(r))] < 0 \quad (12)$$

Thus, $\partial E(p)/\partial r < 0$. ■

Intuitively, increases in the piecemeal liquidation value l effectively reduce the face value at risk for the bank. Figure 2 illustrates how changes in l affect the liquidation recovery rate r and the expected amount of overbidding $E(b_c - v_1)$ for $f = 0.8$ and the uniform distribution. Here, $E(b_c - v_1)$ equals the shaded area above the diagonal line and below $f - l$. Increases in l increase r and decrease $E(b_c - v_1)$. The figure shows three alternative values of l: $l = 0.0$, $l = 0.1$, and $l = 0.2$. The corresponding expected amounts of overbidding are represented by the shaded areas below $f - l = 0.8$, $f - l = 0.7$, and $f - l = 0.6$, respectively. The downward shifts in $f - l$ reduce the region for overbidding.

Proposition 3 forms the basis for our cross-sectional empirical tests of overbidding. If the firm is sold as a going concern (reflecting $v_i > 0$ and therefore $p > 0$), and provided that the bank's debt is impaired ex ante at the piecemeal liquidation value (so that $r < 1$), the proposition holds that r affects the final winning price through $E(b_c)$. A first-order test of the theory is therefore achieved by regressing p on r. Overbidding implies a negative coefficient on r in this regression. Specifics of the test approach are found in Section 4 below.

3 Data and sample characteristics

3.1 The auction setting

When a company files for Swedish bankruptcy, the control rights are transferred to a court-appointed trustee who puts the firm up for sale in an open first-price auction. Buyers are free to place bids for individual assets (piecemeal liquidation) or for the entire firm (going concern sale). The highest bid wins, so going concern offers dominate competing piecemeal liquidation bids. We do not observe auctions with a mix of piecemeal liquidation and going concern bids, possibly because it is common knowledge among bidders when a company's going concern value is close to zero and the firm should be liquidated piecemeal. In general, the bidding process is open for one month and the firm is sold within 2 months of filing (Thorburn, 2000).

The firm and its business operations receive protection during the auction bankruptcy procedure, much as in Chapter 11. Debt payments and collateralized assets are stayed. The incumbent management team is often retained to run the operations under the trustee's supervision until the sale is completed. Bankruptcy law permits operating costs incurred while in bankruptcy to be paid in cash, effectively granting these costs super-priority status. While the law also permits debtor-in-possession financing, such debt issues are never observed, reflecting the swift auction process.

Bidders are required to pay in cash. They often form a shell company that, financed by debt and equity, acquires the bankrupt firm's assets much like in an LBO. Alternatively, the bidder merges the bankrupt target with its own operations. The cash proceeds from the auction, net of the trustee's fees and expenses, are distributed to creditors strictly according to the absolute priority of the debt claims. For the average sample firm, the debt structure is as follows (Thorburn, 2000): rent and audit costs (senior to the bank) 1%, bank debt 39%, tax and wage claims (junior to the bank) 28%, and trade credits (junior to all other claims) 32%.

The trustee's fiduciary duty is to creditors. The auction process and outcome is monitored by a government supervisory agency (TSM). If an insider of the bankrupt firm is the only bidder (attempting a saleback of the firm), the trustee is required to search for competing bids. Moreover, firms sometimes negotiate a sale of the assets right before filing. While such prepackaged arrangements (refereed to below as "auction prepacks") are subject to approval by the trustee and secured creditors, they are rarely overturned (Thorburn, 2000). The trustee does not provide the piecemeal liquidation value estimate l for auction prepacks. We return to the implication of this in the empirical analysis below.

3.2 Characteristics of auctioned firms

We use a sample of 260 bankruptcy cases between 1/1988 and 12/1991 originally compiled by Strömberg and Thorburn (1996) and Thorburn (2000), drawn from the population of 1,159 bankrupt Swedish companies with at least 20 employees. The sample is restricted to bankruptcies in the four largest administrative provinces in Sweden, including the country's four main metropolitan areas, Stockholm, Gothenburg, Malmö and Uppsala. We expand the sample information with auction characteristics—including final auction prices—required to test our overbidding hypotheses. Liquidation-value estimates and bid information are obtained from trustee reports and in direct communication with trustees. Data on bank financing of bidders are from the national register of corporate floating charge claims ("Inskrivningsmydigheten för Företagsinteckning") and complemented by the trustees. Company financial statements for all Swedish firms with at least 20 employees are obtained from UpplysningsCentralen (UC) AB. As described below, this information is used to construct a measure of industry-wide financial distress.

As shown in Panel A of Table 1, 53 firms (20% of the sample) are sold as going concerns in a prepack. Of the remaining 207 firms auctioned off in bankruptcy, 147 (61%) are sold as a going concern and 60 (29%) are liquidated piecemeal. Panel A also shows the distribution of sample firms across different industries. Almost one-third of the sample (81 firms) is in the manufacturing industry. The remaining firms are distributed between construction (37 firms), transport (28 firms), hotels and restaurants (28 firms), trade and retail of goods (45 firms) and services (41 firms). A relatively large fraction of firms in the transport industry (12 firms or 43%) are liquidated piecemeal, while a relatively large fraction of firms in hotels and restaurants (9 firms or 32%) and trade and retail of goods (15 firms or 33%) are sold in prepacks.

Panel B of Table 1 shows selected firm characteristics from the last financial statement reported prior to bankruptcy filing. The sample firms are small, with an average book value of assets of $2.3 million (median $1.2 million) and sales of $4.7 million. The mean (median) number of employees is 43 (29). Operating profitability is generally poor, with a mean (median) ratio of EBITDA/sales of -0.2% (1.8%), and firms are highly leveraged with typical debt levels exceeding 90% of book value of assets. All firms in the sample are privately held and have concentrated ownership. At bankruptcy filing, the CEO owns on average 60% of the equity. There is no discernible difference in the financial ratios between firms sold in prepacks, auctioned as going concerns or liquidated piecemeal.

3.3 Bid activity and auction premiums

The trustees keep records of potential bidders who show an interest in buying the firm's assets. These potential rivals induce competitive bidding also when their interest fails to translate into an actual bid, since a low offer may encourage entry. In the empirical analysis below, we condition premium regressions on the level of potential competition in the auction.

We have data on bidder interest in 195 cases. As shown in Panel A of Table 2, in 77 (75%) of 102 going-concern sales in bankruptcy, multiple bidders express an interest in participating in the auction. In the sample of auction prepacks, we find bid competition in only 5 (15%) of 33 cases. This data may, however, be incomplete since the trustee in prepacks approves the firm's purchase agreement after the buyer has been selected. In piecemeal liquidations, where bids are for individual assets, there is multiple bidder interest in 16 (80%) of 20 auctions.

The filing firm's bank can help increase liquidity in the auction by offering financing to bidders. Panel A of Table 2 presents information on the bank financing of the winning bidder for a total of 130 going concern sales. The bank finances the winning bidder in half (49%) of the cases, distributed as 20 of 35 auction prepacks and 44 of 95 going-concern auctions. When the old bank does not finance the winning bidder, it either finances a losing bid or none of the bids. There are, however, no public records of bank financing commitments for losers in the auction. Overall, we conclude that the bankrupt firm's bank adds liquidity to the bankruptcy auctions.

Panel B of Table 2 lists the average and standard error of the mean for the auction premium and bank debt recovery rates. The auction premium is the price paid by the winning bidder in the auction in excess of the trustee's liquidation value estimate for the assets sold in the auction(l^a). This value estimate, which is the sum of the individual second-hand values of the assets, is produced by industry experts. Non-core assets such as real estate holdings, accounts receivables, securities, cash holdings, etc., are often sold or collected separately also when the firm's core operations are auctioned as a going concern. Thus $l^a < l$, where l denotes the trustee's estimate of the target's total piecemeal liquidation value at the start of the auction (used to define r). We use the bankruptcy file to infer the asset exclusion in l^a.

The premium p averages 8% for piecemeal liquidations with a standard error of 0.08. Using a standard t-test, we cannot reject the hypothesis that $p = l^a$ in piecemeal liquidations. In contrast, the premium paid in going-concern auctions averages 125% with a standard error of 0.24. The p-value for the difference in average premiums across going-concern sales and piecemeal liquidations is 0.00. Competition to run the surviving firm may explain the substantially greater premiums when the firm is sold as a going concern. The trustee typically does not report a piecemeal liquidation value estimate for auction prepacks, precluding a premium comparison for this subsample.

Turning to recovery rates, Panel B shows the bank's liquidation recovery rate r as well as the actual debt recovery rate. Recall that Proposition 3 defines r as $min[l/f, 1]$, where f is the face value of the bank's debt. This definition assumes that the bank is the firm's only senior creditor. In our data, however, there is on average 1% of total debt outstanding that is senior to the bank's claim. Denoting this debt as s, we modify the definition of the liquidation recovery rate to $r \equiv min[(l - s)/f, 1]$. The rescaling of l is purely for empirical purposes and does not affect the above theoretical predictions involving r.

The average value of r is 45% in piecemeal liquidations and 66% in going-concern auctions. This difference is statistically significant at the one percent level, indicating that firms that are liquidated piecemeal tend to have more impaired bank debt at the outset of the auction. The frequency distribution of r for going-concern auctions and piecemeal liquidations is plotted in Figure 4. The bank receives full recovery at the trustee's piecemeal liquidation value estimate in 58 bankruptcy filings (30%). The 138 cases with less than full liquidation recovery are evenly distributed across the range of r from 0 to 99%.

The actual distribution to banks (bank realized recovery rate) averages 69% (median 83%) of the face value of bank debt. Bank recovery rates are on average significantly higher in prepacks and going-concern auctions (77% and 76%, respectively) than in piecemeal liquidations (46%), again reflecting the additional value created in auctions where the going-concern value of the firm is preserved. The distribution of the realized bank recovery rate in going-concern sales and prepacks are shown in Figure 5.

4 Does coalition overbidding exist?

4.1 Testing the overbidding theory

Our approach to testing Proposition 3 is summarized in hypothesis H1:

> **H1 (Overbidding):** *In a regression of the ex post going-concern premium p on the bank's ex ante liquidation recovery rate $r \equiv min[(l-s)/f, 1]$, let β denote the regression coefficient on r. Proposition 3 predicts that $\beta < 0$ when the auction results in a going-concern sale. Moreover, $\beta = 0$ when $r = 1$ (the bank debt is not impaired ex ante), and when the firm is liquidated piecemeal (there is no going-concern premium).*

We use a cross-sectional regression framework to test H1, where the log-auction premium $ln(p)$ is regressed on r as well as on a vector X of control variables. Structurally, the direction of causality in this cross-sectional regression runs from r (observed at the beginning of the auction) to the auction premium (determined ex post) through the hypothesized incentive to overbid. Also, in our institutional setting, it is safe to assume that r is exogenous to the bank.[11]

Table 3 lists the variable definitions for the cross-sectional regressions. The control variables in X include $Piecemeal$ (indicator for piecemeal liquidation), $Size$ (natural logarithm of book value of total assets), $Profmarg$ (pre-filing industry-adjusted operating profitability), and $Tangible$ (fraction of secured debt in the capital structure). Assuming that firms tend to lever up their tangible assets, $Tangible$ is a proxy for asset tangibility.[12]

Table 4 shows our main test results for the overbidding hypothesis. Panel A uses the total sample of 175 going-concern sales and piecemeal liquidations with available data on l and p.[13] The first row of Table 4 shows the impact of r on $ln(p)$ for the full sample of auctions. The regression has an adjusted R^2 of 0.15. The coefficient on r is -0.90 with a p-value of 0.00, which is consistent with H1: auction premiums decrease in the bank's ex ante liquidation recovery rate. As for the control variables, the coefficient for $Piecemeal$ is always negative and significant, which confirms the earlier evidence in Table 2. Auction premiums are on average lower in piecemeal liquidations

[11] A bidder anticipating the bankruptcy event might attempt to acquire the bank's toehold by purchasing the distressed debt ahead of bankruptcy filing. However, there was no secondary market for bank debt in Sweden during our sample period.

[12] This argument holds *a fortiori* for cash-constrained distressed firms. These firms often use all available debt capacity by borrowing against tangible assets.

[13] As indicated earlier, l is unavailable for the 53 auction prepacks. We return to the auction prepacks below.

than in going-concern sales, reflecting the absence of a going-concern premium. Of the remaining control variables, only *Tangible* is statistically significant. The negative coefficient indicates that bidders pay lower premiums for targets that have a relatively high proportion tangible assets.

Overbidding is restricted to going-concern sales as there is no rents to be extracted from bidders when the target is liquidated piecemeal. To check for this effect of the auction outcome, the second and the third regressions of Panel A permit r to have different impacts across going concern sales (indicated by the binary variable *Concern*) and piecemeal liquidations. The two regression specifications are as follows:

$$ln(p) = \begin{cases} \alpha + \beta_2 r \times Piecemeal + \beta_3 r \times Concern + \gamma X + \epsilon \\ \alpha + \beta_1' r + \beta_2' r \times Piecemeal + \gamma X + \epsilon \end{cases} \tag{13}$$

where α is the constant term, γ is the vector of regression coefficients for the control variables in X, and ϵ is an error term. In the first regression, β_2 and β_3 capture the separate effects of overbidding in piecemeal liquidations and going-concern auctions. The second regression directly tests whether the two coefficient estimates are significantly different from each other. To see why, note that the second regression can be rewritten as $\alpha + \beta_1' r(Piecemeal + Concern) + \beta_2' r \times Piecemeal + \gamma X + \epsilon$. Comparing the two regressions, we have that $\beta_1' \equiv \beta_3$, and that $\beta_2' \equiv \beta_2 - \beta_1' \equiv \beta_2 - \beta_3$. H1 predicts that $\beta_2 = 0$, $\beta_3 < 0$, and $\beta_2' > 0$ (i.e. that $\beta_2 > \beta_3$).

All of these predictions are borne out in the data. In the second regression of Panel A, the coefficient β_2 for $r \times Piecemeal$ is indistinguishable from zero (p-value 0.68), suggesting that there is no overbidding in piecemeal liquidations. The coefficient β_3 for $r \times Concern$ is negative and highly significant, confirming the prediction of an overbidding effect in going concern sales. In the third regression of Panel A, $\beta_2' = 1.01$ with a p-value of 0.01, confirming that the impact of r on the auction premium is significantly different across going concerns and piecemeal liquidations.

According to our theory, overbidding is limited to cases where the bank's debt is impaired at the liquidation recovery rate. Panel B of Table 4 repeats the regressions from Panel A on the subsample of auctions where $r < 1$. This eliminates 55 cases. All but one of the regression coefficients in Panel B are close to those in Panel A, both in terms of magnitude and significance levels. Specifically, the coefficient estimate for r is again negative and highly significant (p=0.00) for the full sample of 120. Moreover, the coefficients for $r \times Concern$ (β_2) is negative and significant (p=0.00), while the coefficient for $r \times Piecemeal$ (β_1) is not significantly different from zero. The estimate of β_2', however, is now 0.89 with a p-value of 0.13. Overall, the regression results in Table 4 strongly suggest that lower values of the liquidation recovery rate r result in higher auction premiums for going concern sales, while no such effect is discernible for piecemeal liquidations, as predicted by H1.

4.2 Robustness tests

The coefficient estimate on r in the above regressions ignores the potential for estimation error in the liquidation value estimates l and l^a. The auction price data shows that this estimation error is small on average: recall from Table 2 that final market prices in the piecemeal liquidation category are on average only 8% higher than the piecemeal liquidation value estimate l^a.[14] A more important issue is the fact that the liquidation value appears on both sides of the regression equation ($ln(p)$ contains $1/l^a$ and r contains l) and may therefore in part be driving the negative coefficient estimate on r. Below, we resolve this issue by isolating the range of r where overbidding does not exist in theory but in which the mechanical correlation remains present, and by orthogonalizing the effect of l on r. Second, we examine the robustness of our overbidding evidence with respect to the exclusion of prepack auctions (for which we do not have data on l). Third, since the theoretical overbidding function (Proposition 1) is nonlinear, we test whether the data rejects the linearity assumption behind our cross-sectional regressions. Our main conclusions appear robust to all of these specification issues.

4.2.1 The role of the piecemeal liquidation value

Recall from Eq. (1) that when the bank's debt is not impaired, $(l - s)/f \geq 1$ so $r = 1$ and there is no overbidding. Since r is truncated at one, it does not capture the cross-sectional variation in

[14] Even with estimation error, the impact on the coefficient on r is likely to be negligible. Write $l = \hat{l}u$, where $\hat{l}$ is the true liquidation value and u is a (multiplicative) measurement error. Let P denote the price paid in the auction, and consider a regression of the form $ln(P/l) = \alpha + \beta ln(l/f) + e$. Taking the logarithm, $P - \hat{l} - u = \alpha + \beta(\hat{l} - u - f) + ln(e)$. If we assume that $Cov(P - \hat{l}, \hat{l} - f) = 0$, then the bias in β from the measurement error in l is small—on the order of $\sigma_u^2/(\sigma_{f-\hat{l}}^2 + \sigma_u^2)$, where σ^2 is the variance.

$(l - s)/f$ when this value exceeds one. Define the variable r^* such that:

$$r^* = \begin{cases} (1-s)/f & \text{if r} = 1 \\ 0 & \text{if r} < 1 \end{cases} \tag{14}$$

While Proposition 3 predicts a coefficient value of zero for r^*, the negative correlation between $ln(1/l^a)$ and l affects r and r^* equally. Therefore, if this correlation is in fact driving the negative coefficient estimate for r reported in Table 4, we should observe a negative coefficient estimate for r^* as well.

We test this hypothesis in Table 5. In the first regression, which uses the full sample, the coefficient on r is -1.01 (p=0.00). This estimate is close to that reported earlier for the full sample in Table 4. More importantly, the coefficient estimate for r^* is only 0.02 with a p-value of 0.39. The finding of an insignificant coefficient estimate for r^* is reinforced by the results in panels B and C. In Panel B, where the sample is restricted to going-concern sales, the coefficient on r is again negative and significant, while the coefficient on r^* is close to zero and insignificant. In Panel C, where we restrict the sample to cases where $r = 1$ (no overbidding), the coefficient estimate for r^* remains close to zero. These results suggest that the negative correlation between $ln(1/l^a)$ and l has only a negligible effect on the coefficient estimate for r. This evidence strengthens the empirical support for the overbidding hypothesis.

Turning to the control variables, the inclusion of r^* does not change the impact on auction premiums of *Piecemeal* and *Tangible*, both of which receive negative and significant coefficients as before. The table also includes regressors controlling for auction demand conditions. The variable *Industry distress* measures the degree of industry-wide distress in the year of the bankruptcy filing. This variable is defined as the fraction of firms with the same four-digit SIC industry code as the sample firm that report an interest coverage ratio less than one or files for bankruptcy in the subsequent year. The interest coverage ratio is defined as (EBITDA+interest income)/interest expense. The coefficient estimate for *Industry distress* is insignificant across all regression specifications.[15]

Panel B, which is restricted to going-concern sales, also controls for the degree of competition and a saleback of the firm to target insiders. The former is represented by the binary variable

[15] **?** provide further evidence on the impact of industry illiquidity on bankruptcy auction prices.

Multiple interest which indicates the presence of at least two firms expressing a serious interest in bidding for the target, while the latter is the binary variable *Saleback*. Neither variable affect auction premiums and their inclusion has only a negligible effect on the coefficient estimates for r and r^*, respectively. In Section 2, we argue that since it is common for owner-managers of small firms to issue a personal guarantee of the company's bank debt, owner-managers may have their own incentives to overbid. The insignificance of *Saleback* reported here suggests that any such incentives do not on average have a separate premium impact—beyond what is already captured by our measure of bank-debt impairment r. The regressions in Panel D show that inclusion of *Industry distress* does not affect the coefficient estimate for r in the sample of piecemeal liquidations. In this regression, and consistent with the overbidding theory, r receives an insignificant coefficient.

Table 6 provides a final robustness check of whether the coefficient estimate for r is driven by the negative correlation between $ln(1/l^a)$ and l. In this table, we first estimate the impact of l on r through an OLS regression $r = \gamma_0 + \gamma_1 ln(l) + r_\epsilon$. By construction, the residuals r_ϵ are orthogonal to $ln(l)$. We then replace r with r_ϵ in the premium regressions. As shown in the table, r_ϵ receives a negative coefficient estimate of the same magnitude as r and is highly significant with p=0.00 across the full sample (Panel A) and going-concern auctions (Panel B), and it is insignificant for piecemeal liquidations (Panel C). These results are again as predicted by our overbidding theory, and they rule out a confounding effect of the correlation between $ln(1/l^a)$ and l.

4.2.2 Auction prepack selection

As discussed above, because the trustee typically does not provide a piecemeal liquidation value estimate l for auction prepacks, our premium regressions exclude this category of auctions. When approaching bankruptcy, however, the firm self-selects whether to do an ordinary bankruptcy filing or to find a buyer and file an auction prepack. For example, the firm may prefer to work out a private auction prepack agreement if the bankruptcy auction itself is expected to be illiquid and produce low prices (**?**). If so, since the sample truncates observations for l in prepacks, the OLS estimates of the coefficient vector β reported in earlier tables may be biased.

We use a two-step Heckman (1979) procedure to control for this truncation problem. To illustrate, suppose the firm selects a prepack filing based on $\gamma' Z$, where Z is a vector of explanatory variables and γ is a vector of coefficients. If so, the true data generating process is

$$ln(p) = \begin{cases} \beta' X + u & \text{if} \quad \gamma' Z > u_z \quad \text{(nonprepack filing)} \\ \beta_1' X + u_1 & \text{if} \quad \gamma' Z \leq u_z \quad \text{(prepack filing)} \end{cases} \tag{15}$$

where u_z is the residual from the choice model $\gamma' Z$. To account for this self-selection, we first estimate the coefficients γ using probit for a regular (nonprepack) filing, where Z contains *Industry distress*, *Size*, *Profit margin*, and *Tangible*. These variables reflect the effect of industry-wide distress on auction illiquidity and the going-concern value that may be lost if the auction is illiquid, both of which may induce an auction prepack. We then perform the following second-step regression using weighted least squares:

$$ln(p) = \beta' X + \eta \frac{\phi(\gamma' Z)}{\Phi(\gamma' Z)} + u, \tag{16}$$

where ϕ_i and Φ in the inverse Mill's ratio are the values of the standard normal density and the cumulative normal distribution functions, respectively, evaluated at $\gamma' Z$.

The estimate of η and the coefficient vector β are shown Table 7. In Panel A, we use the full sample of 175 firms auctioned in bankruptcy, while Panel B is restricted to 130 going-going concern auctions. The Mill's ratio receives an insignificant coefficient in all specifications, suggesting that it is not necessary to control for prepack selection to generate unbiased estimates of β. The estimates of β in Table 7 are similar to those reported above, with the exception of the coefficient for *Tangible* which is now insignificant. Importantly, the coefficient estimate for r again supports the overbidding hypothesis H1.

4.2.3 Linearity of the overbidding function

We have so far presumed a linear relationship between the winning auction premium and the coalition's overbidding incentive. As depicted in Figure 2, the relationship is linear for the case of the uniform distribution and $v_1 < f - h(b_c)$. However, the relationship may be non-linear (concave) for other distributions $G(v)$. Since our theoretical model does not identify the functional form G, we apply a Box-Cox transformation to r.[16] A Box-Cox transformation of the variable r, denoted

[16] See, e.g., Judge, Hill, Griffiths, Lutkepohl, and Lee (1988) pp. 555-563.

$r^{(\lambda)}$, is defined as

$$r^{(\lambda)} = \begin{cases} (r^{\lambda} - 1)/\lambda & \lambda \neq 0 \\ \ln r & \lambda = 0. \end{cases} \tag{17}$$

The resulting maximum likelihood estimate of λ determines the functional form of the relationship with auction premiums, where $\lambda = 1$ implies linearity. Using the subsample of auctions where $r < 1$, the Box-Cox transformation results in an estimated value of λ of 1.53 with a p-value of 0.69. This estimate is statistically indistinguishable from either zero or one.

As a sensitivity analysis, we rerun the premium regression using a transformation of r with $\lambda = 1.53$ and $\lambda = 0$. The results are shown in Table 8. For the subsample of going-concern sales (Panel A), the coefficient estimate for $r^{(\lambda)} = (r^{1.53} - 1)/1.53$ is -1.48 with a p-value of 0.00. In Panel B, we repeat the regression with $\lambda = 0$, which results in a coefficient estimate for $r^{(\lambda)} = ln(r)$ of -0.35 and a p-value of 0.00. Finally, in Panel C, we again use $\lambda = 0$ but the sample is now restricted to piecemeal liquidations. The coefficient estimate for $r^{(\lambda)} = ln(r)$ is now an insignificant -0.12 (p-value of 0.74). This evidence is uniformly consistent with the overbidding hypothesis H1 also when we allow a non-linear functional form for the overbidding variable r.

4.3 Agency and overbidding through bank-debt rollover

In the overbidding theory of Section 2, bank managers are assumed to work in the bank's interest: the coalition bid strategy maximizes expected auction revenue. Alternatively, suppose bank managers are entrenched. If revealing credit losses lowers bank managers' reputation, they may try to rig the auction outcome by getting the bidder to roll over the bank's debt at face value. Using the notation from Section 2, and ignoring the piecemeal liquidation value ($l = 0$), the coalition agreement is for bidder 1 to offer $b'_c = max[f + s, v_1]$ and for the bank to transfer the overpayment amount $max[f + s - v_1, 0]$ to bidder 1 conditional on winning.[17]

Under the rollover hypothesis, the bank is effectively trying to enforce a price floor (a seller reserve price) of $f + s$. Therefore, the auction must now be strictly first-price. The central implication of this setup hypothesis is that the bank will always achieve full repayment f of its debt. Notice also that the rollover strategy implies greater expected overbidding than under our overbidding

[17]Since the transfer $f + s - v_1$ increases dollar for dollar as v_1 falls below $f + s$, the bank manager has an incentive to select a coalition partner with high private valuation v_1. In contrast, in Section 2, the coalition is "bidding to lose", so the bank prefers coalition partners with low private valuations v_1.

hypothesis in Section 2. In terms of Figure 1, the additional expected amount of overbidding—which the bank must transfer ex post to its coalition partner—is equal to the area of the triangle between the lines for f and b_c. This aggressive overbidding also results in a higher probability that the coalition wins against more efficient rivals ($b_c > v_2 > v_1$).

The prediction of full recovery for the bank is testable. Starting with the full sample of 236 auctions with data on bank recovery rates, the bank receives full debt recovery in 34% of the total sample. Focusing on the 181 going-concern sales and prepacks (excluding piecemeal liquidations), the bank receives full recovery in 40% of the cases. As shown in Figure 5, for the 60% of the sample with less than full bank recovery, realized bank recovery rates are evenly distributed between 0.40 and 0.90. Cases where the bank receive less than full recovery are inconsistent with debt rollover.

The most interesting place to look for debt rollover is when the bank-bidder coalition wins and the coalition partner is a former owner-manager (i.e. a saleback). In the total sample of 111 salebacks, the bank finances the bidder in 42 cases. In 22 of these cases (52%), the bank receives full recovery. Are these 22 cases the result of debt rollover? Within this group of 22, the average auction price exceeds $f + s$ by 91% (median 40%). That is, the bank's coalition partner pays a price in the auction than on average nearly doubles the bank's face value f. The bank receives full recovery because bidder 1's valuation is high ($v_1 \approx 2(f + s)$) and not because of an attempt to rig the auction. Our overall conclusion is therefore that debt rollover is not an important characteristic of these bankruptcy auctions.

5 Overbidding and post-bankruptcy performance

Our empirical analysis suggests that creditor overbidding-incentives manifest themselves in actual auction prices. As shown in Section 2 (Figure 3), overbidding may lead to an inefficient auction outcome. When the bank-bidder coalition overbids and lose, bidder 2 has the highest private valuation, and the outcome is efficient. However, when the coalition overbids and wins, there are two possibilities: if $v_1 > v_2$ the outcome is efficient, while allocative inefficiency occurs when $v_1 < v_2$.

What is the likely empirical relevance of the case where the coalition wins and bidder 2's private valuation exceeds that of bidder 1? As bidder private valuations are unobservable, this question can only be assessed indirectly. Since severe allocative inefficiency arguably results in poor post-bankruptcy performance, we provide performance evidence as a function of our measure of overbidding incentive r. Because the sample firms are all private, we use operating profitability and bankruptcy refiling rates as measures of performance.

> **H2 (Overbidding and performance):** *Since the overbidding incentive is decreasing in the liquidation recovery rate r (Proposition 3), the likelihood of the inefficient auction outcome is also decreasing in r. If overbidding impacts allocative efficiency, average post-bankruptcy operating performance and bankruptcy refiling rates are expected to be greater following auctions with a high value of r than in auctions with a low value of r.*

5.1 Post-bankruptcy operating performance

Post-bankruptcy performance estimation requires the identity of the newly restructured firm. We have this information for a total of 111 of our targets sold as a going-concern and excluding prepacks. Within this subsample, post-bankruptcy financial statements are available for a total of 83 firms in the first year post-bankruptcy (year 1). Panel A of Table 9 reports median annual industry-adjusted operating profitability (EBITDA/sales) for groups of auctions with high and low values of the overbidding incentive r, and for the difference between two groups. As defined in Table 3, r_{high} indicates that $r = 1$, and r_{low} indicates that $0 < r \leq 0.5$. This eliminates 27 observations with $0.5 < r < 1$ and an additional five observations with missing information on r.

Moreover, we compare the performance across firms sold in auctions where the bank finances the winning bidder ($Bank = 1$) and auctions where the bank did not finance the buyer ($Bank = 0$). When using the variable *Bank*, twenty-one of the 83 firms with post-bankruptcy financial statements are eliminated due to missing information. Industry-adjusted is defined as the difference between the firm and its median industry rival, where a rival is a firm with at least 20 employees and with the same four-digit SIC industry code as the target.

Using a Wilcoxon signed-rank test, the typical sample firm has an operating profitability that is statistically indistinguishable from its median industry rival for each of the four years following bankruptcy. The p-values for the difference between auctions with high and low values of r are also high in all four years. The same holds when we condition the sample on the indicator *Bank*.

In principle, the greatest potential for an inefficient outcome in occurs when the coalition wins ($Bank = 1$) and the overbidding incentives are high ($r = r_{low}$). The third group of observations in Panel A focuses on this subsample by comparing the operating performance across cases with r_{high} and with r_{low} conditional on $Bank = 1$. If overbidding leads to an inefficient outcome, we expect the performance differences shown in the last row of Panel A to be positive and significant. Instead, they are significantly *negative* for years one and two, and insignificant thereafter.

We conclude from Panel A of Table 9 that the median post-bankruptcy operating performance of auctioned targets is typically (1) indistinguishable from the performance of industry rivals, (2) unaffected by whether the bank's ex ante incentive to overbid is high or low, and (3) higher when the coalition wins following high overbidding incentives. This evidence fails to support the joint hypothesis H2 of overbidding and allocative inefficiency.

Panel B of Table 9 shows that the post-bankruptcy leverage ratios of the auctioned firms are significantly higher than that of industry peers in years 1 and 2. There is, however, no difference in the use of leverage across auctioned firms with high or low overbidding incentive r or with or without old bank financing of the winning bidder. The greater leverage ratios after emerging from bankruptcy may however carry with it a greater probability of refiling for bankruptcy, in particular if the firm is restructured by a relatively inefficient buyer. We turn to the refiling rate next.

5.2 Bankruptcy refiling rates

Table 10 presents logit-estimates of the probability of bankruptcy refiling within two years of the auction. The regressions use as explanatory variables the overbidding incentive r and its variants r^*, r_{low}, and r_{high}, as well as the industry- and firm characteristics $Industry\ distress$, $Saleback$, $Bank$, $Size$, $Proft\ margin$, and $Tangible$. The sample contains 106 of the 111 surviving firms, reflecting the missing information on r for five cases.

Of the nine regression specifications in Table 10, only the last four are statistically significant using a standard Chi-square test. All nine regressions produce statistically insignificant coefficients for all of the overbidding variables r. In other words, the bankruptcy refiling rate is unaffected by the bank's ex ante incentive to form a coalition and overbid. The only variable which affects the refiling probability is $Bank$. That is, the refiling rate is significantly greater in the subsample where the bank finances the winning bidder in the auction. Note also that the refiling rate is independent of whether the auction results in a saleback. The important factor appears to be bank financing *per se*, and not whether the buyer is the firm's old owner.[18]

However, when we introduce the interaction variables $r_{low} * Bank$ and $r_{high} * Bank$ (not shown in Table 10), we cannot reject the hypothesis that these two interaction variables have identical coefficients. This means that, while refiling rates are higher when the bidder is financed by the old bank, this effect of $Bank$ is unrelated to whether the overbidding incentives are high or low in the auction. Overall, we conclude that when the bank-bidder coalition wins the auction, the coalition appears to have selected a relatively risky restructuring project (in terms of the refiling rate). Moreover, since the operating performance indicate bidder efficiency also when the bank finances the winner, the greater refiling risk occurs even if the bank's coalition partner is relatively efficient.

6 Conclusions

The Swedish automatic auction system has an attractive simplicity, and it provides an important laboratory for examining the effectiveness of auctions to resolve bankruptcy. Previous research has shown that the auctions result in a speedy and relatively low-cost restructuring of the filing firms with no evidence of excessive liquidation (three-quarters survive as going concerns) or fire-sale discounts in going-concern sales. In this paper, we focus on the incentives and opportunities for the bankrupt firm's main creditor—the bank—to influence the auction outcome in order to increase expected bank-debt recovery. Regulatory constraints prevent banks from bidding in the auction. However, we observe that the old bank frequently finances bidders, and we postulate that the financing arrangement leads to joint bank-bidder offer strategies. The optimal bank-bidder coalition strategy implies overbidding and mimics a monopolist seller's reserve price. Thus, a bank-bidder coalition strategy may allow the bank to circumvent the institutional constraint on bank bidding in the auction.

We test for overbidding using cross-sectional regressions of the final auction premium on a measure of the bank's expected debt recovery rate if the firm is liquidated piecemeal (r). The lower the value of r, the more impaired is the bank's debt claim ex ante, and the greater the

[18]Inclusion of additional variables such as asset specificity, business cycle, and industry leverage does not alter this conclusion.

bank's incentive to form a coalition and overbid. We find robust evidence that auction premiums are decreasing in r. This inverse relationship is statistically significant and as predicted by the overbidding hypothesis. The estimated relationship is robust to the inclusion of various firm- and industry characteristics in the cross-sectional regressions, and to a correction for bidder self-selection of the auction outcome. Moreover, evidence of overbidding occurs only for the relevant range of r (where theory suggests overbidding). To our knowledge, this is the first test of auction overbidding based directly on final auction prices.

Since overbidding by the bank-bidder coalition may lead to inefficient auction outcome (when the coalition wins against a higher-valuation rival bidder), we also examine the post-bankruptcy performance of the auctioned firms. The hypothesis is that larger overbidding incentives in the auction (lower values of r) may lead to lower post-bankruptcy operating performance and/or bankruptcy refiling probability. However, we find that post-bankruptcy operating performance is independent of the ex ante overbidding incentive and whether or not the bank finances the winning bidder. While the bankruptcy refiling rate is greater following bank financing of the winner, this effect is also independent of overbidding incentives. We infer from this that the bank's coalition partner tends to be relatively efficient in terms of restructuring and operating the bankrupt firm's assets. Moreover, bank financing appears to be more likely in auctions where the bankrupt firm's future prospects are relatively risky.

In the U.S., there is a growing use of relatively low-cost, market-based mechanisms to resolve bankruptcy. An interesting question for future research is whether moving towards greater use of auctions would be beneficial in Chapter 11. The answer depends in part on to what extent the Swedish auction mechanism is uniquely suited to the country's legal and corporate governance tradition. For example, there does not appear to be any serious risk of corruption of the auction mechanism itself. Also, the auction mechanism may be better suited for firms with relatively simple capital structures than for the more complex structures involving public ownership of debt. However, the active market for corporate control in the U.S. suggests that neither firm size nor capital structure complexity necessarily impede takeover auctions outside of bankruptcy.

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Figure 1
The bank-bidder coalition's optimal bid, $b_c(v_1)$, and the expected amount of overbidding (shaded area), assuming a piecemeal liquidation value l of zero.

The figure is drawn assuming bidder valuations are distributed uniform, $v_i \sim U[0,1]$. The coalition-bidder's private valuation is v_1, f is the face value of the bank's debt, and $h(b_c)$ is the inverse hazard rate at b_c. When $v_1 \leq 2f-1$, the coalition fully overbids: $b_c = (v_1+1)/2$. When $f > v_1 > 2f-1$, the coalition partially overbids: $b_c = f$. When $v_1 \geq f$, the coalition does not overbid: $b_c = v_1$.

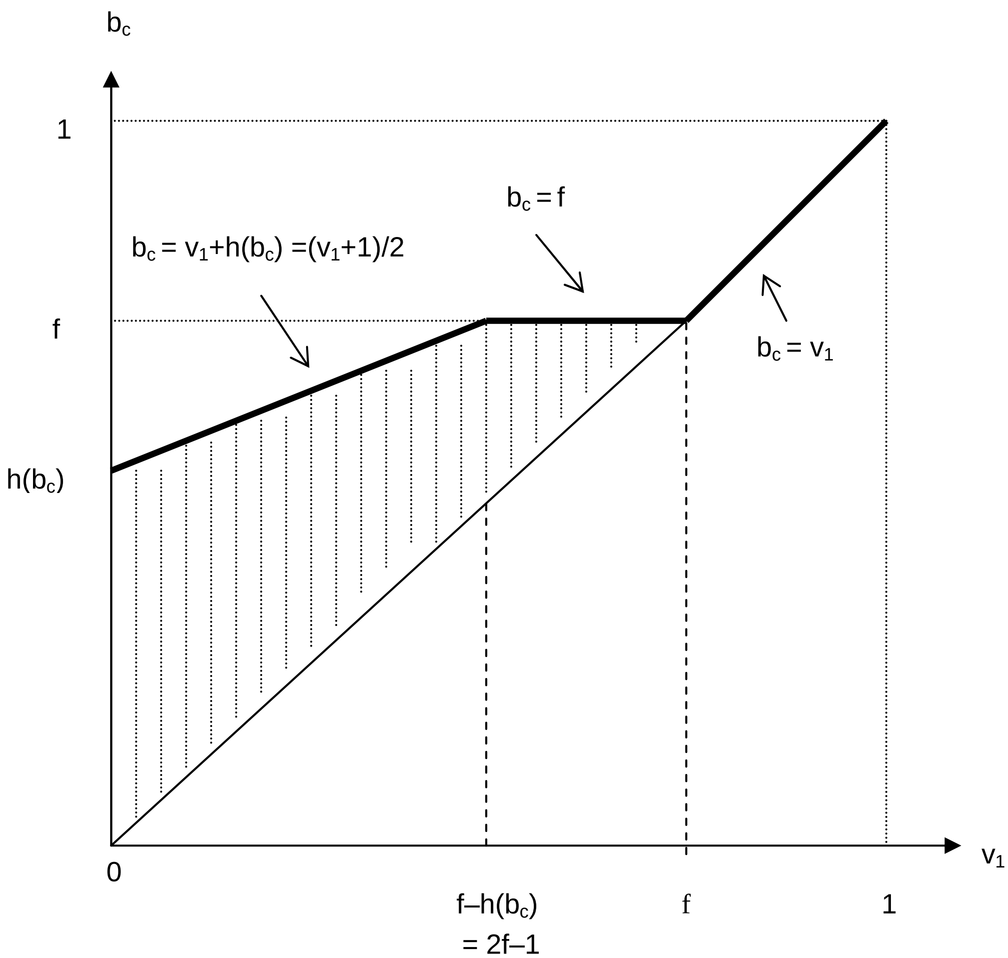

Figure 2
The expected amount of coalition overbidding for different values of the piecemeal liquidation value l.

The figure illustrates how changes in l affect the expected amount of overbidding $E(b_c - v_1)$, where b_c is the coalition's optimal bid and v_1 is the coalition bidder's private valuation (distributed uniform). The face value of the bank's debt claim is set to $f = 0.8$. $E(b_c - v_1)$ equals the shaded area above the diagonal line (v_1, bidder 1's optimal bid with no overbidding) and below $f - l$. As l increases, the bank's liquidation recovery rate $r = min[l/f,\ 1]$ increases and $E(b_c - v_1)$ decreases. The figure is drawn for three alternative values of l: $l = 0.0$, $l = 0.1$, and $l = 0.2$. The corresponding expected amounts of overbidding are the shaded areas below $f - l = 0.8$, $f - l = 0.7$, and $f - l = 0.6$, respectively. Thus, the downward shifts in $f - l$ reduce the region for overbidding.

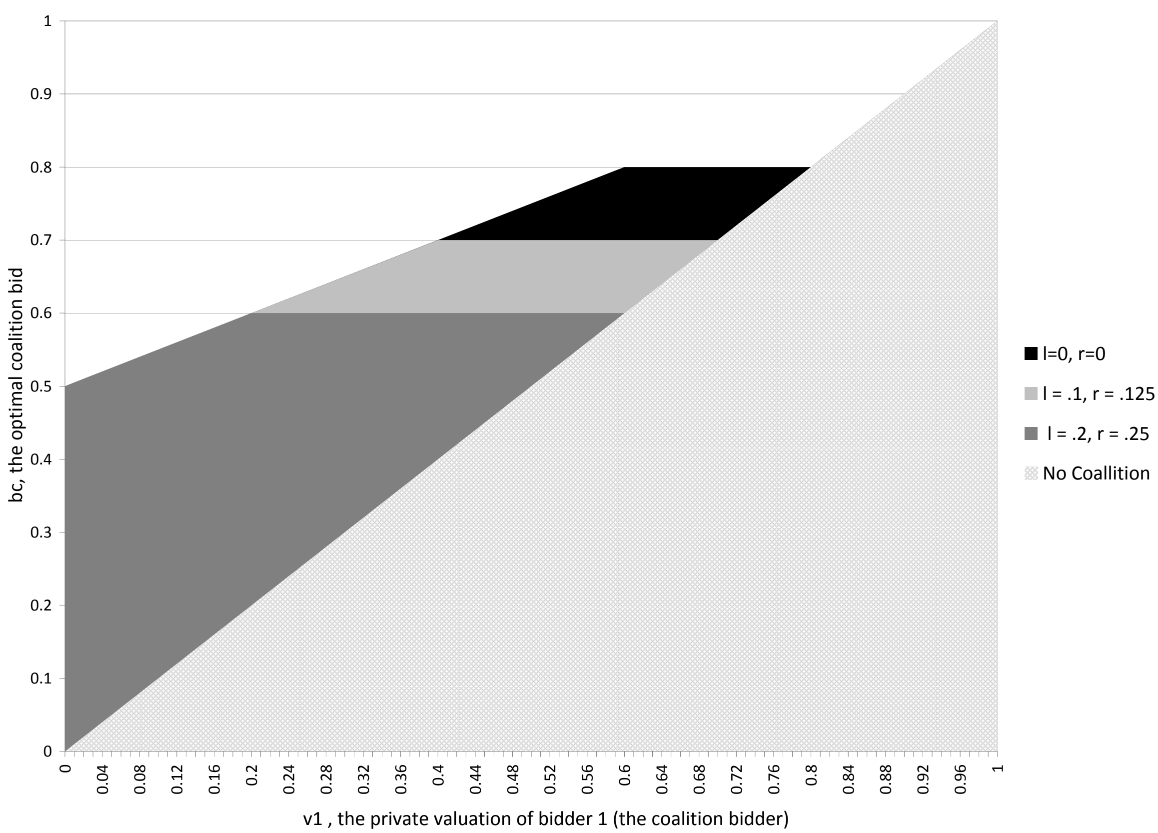

Figure 3
Expected profits with and without coalition bidding.

The figure is drawn assuming bidder valuations are distributed uniform, $v_i \sim U[0,1]$. $G(v_2)$ is the cumulative distribution over v_2. Bidder 2's optimal bid is $b_2 = v_2$ (the diagonal line) and the coalition's optimal bid is b_c. Area A is the expected profits to Bidder 1 and C is the bank's expected revenue under non-cooperative bidding. With coalition bidding, area E is bidder 1's expected cost of overbidding (the minimum transfer), and area E+D is the bank's expected net revenue from overbidding. Thus, area D is the coalition's expected net surplus from overbidding (which equals the expected wealth transfer from bidder 2).

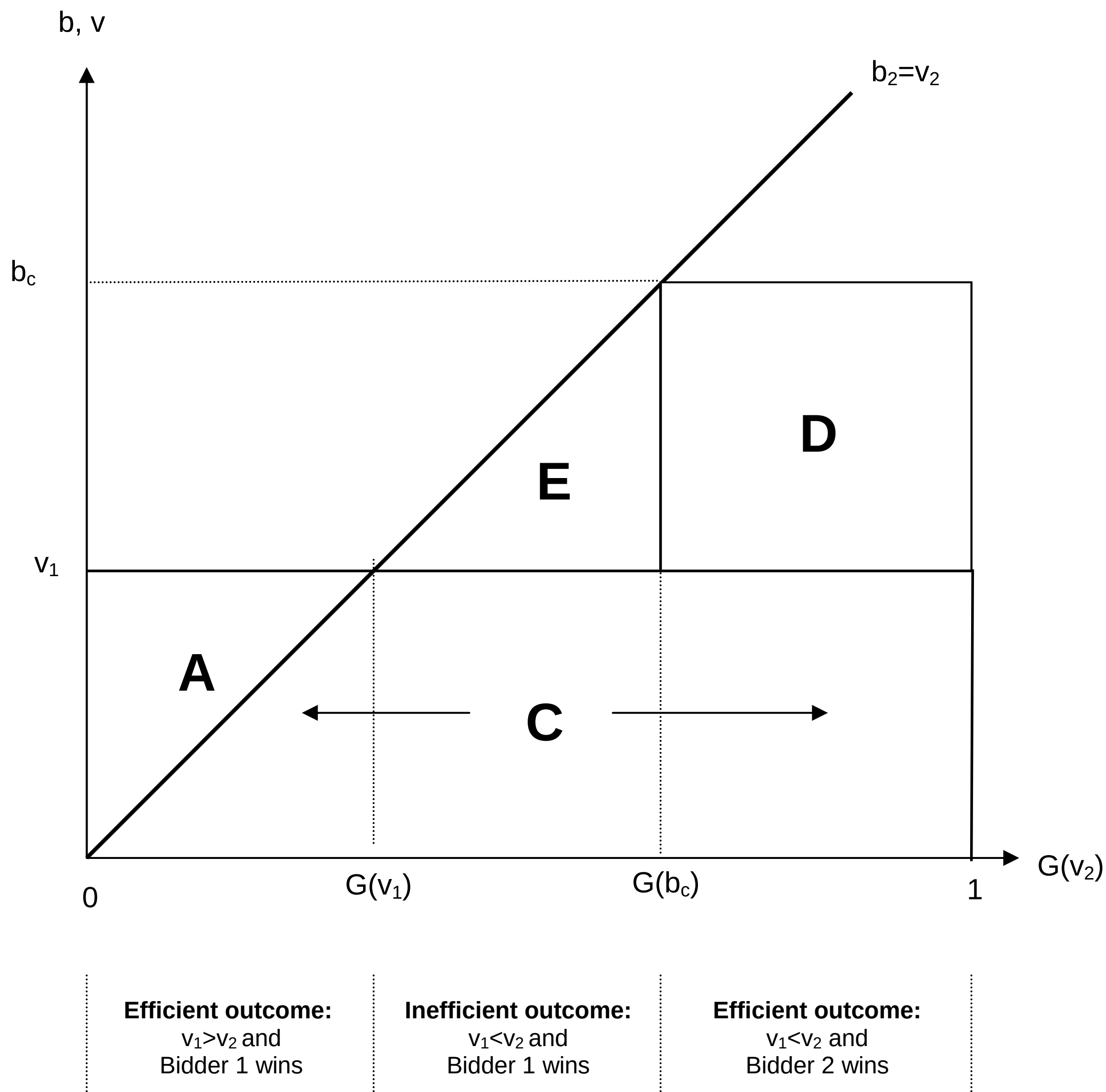

Figure 4
Frequency distribution of the liquidation recovery rate r at the beginning of the auction.

The liquidation recovery rate is $r = min[l/f, 1] * 100\%$, where l is the bankruptcy trustee's estimate (provided at the beginning of the auction) of the bankrupt firm's piecemeal liquidation value and f is the face value of the bank's debt. Sample of 196 bankruptcy auctions, excluding auction prepack filings.

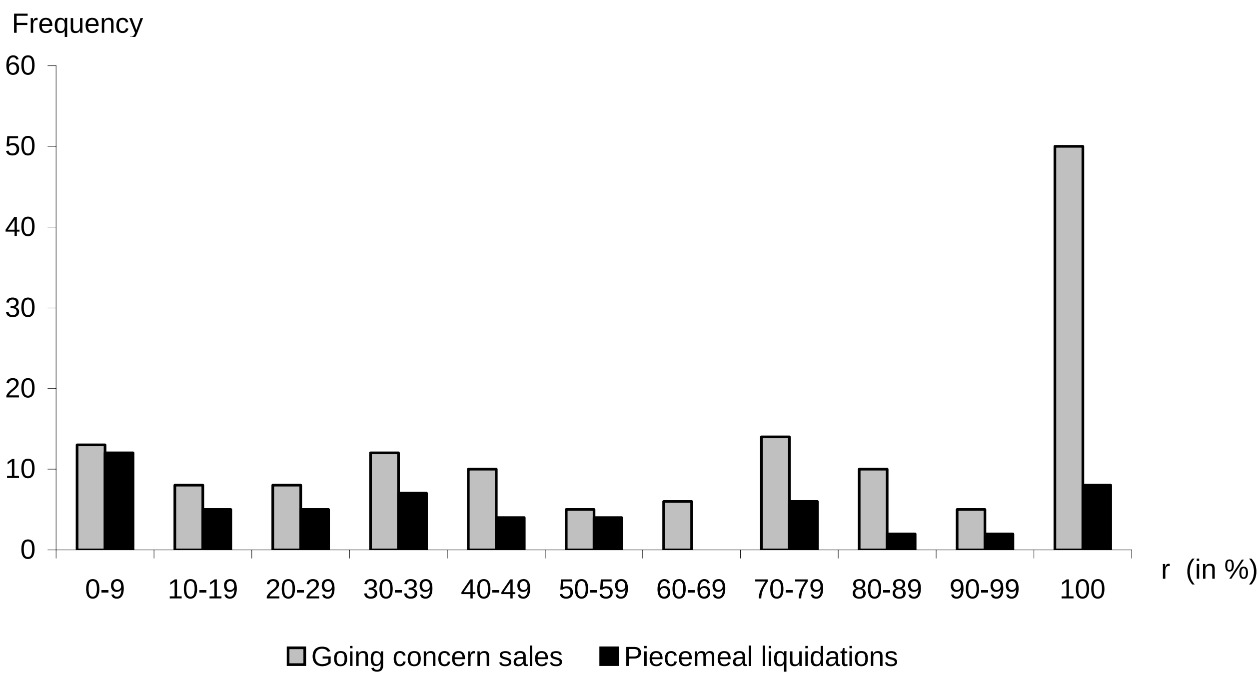

Figure 5
Frequency distribution of the bank's realized debt recovery rate.

The bank's realized recovery rate is its payoff in bankruptcy as a fraction of the face value of its debt claim on the bankrupt firm. Sample of 181 Swedish firms auctioned as a going-concern or filing a prepackaged bankruptcy, excluding piecemeal liquidation, 1988-1991.

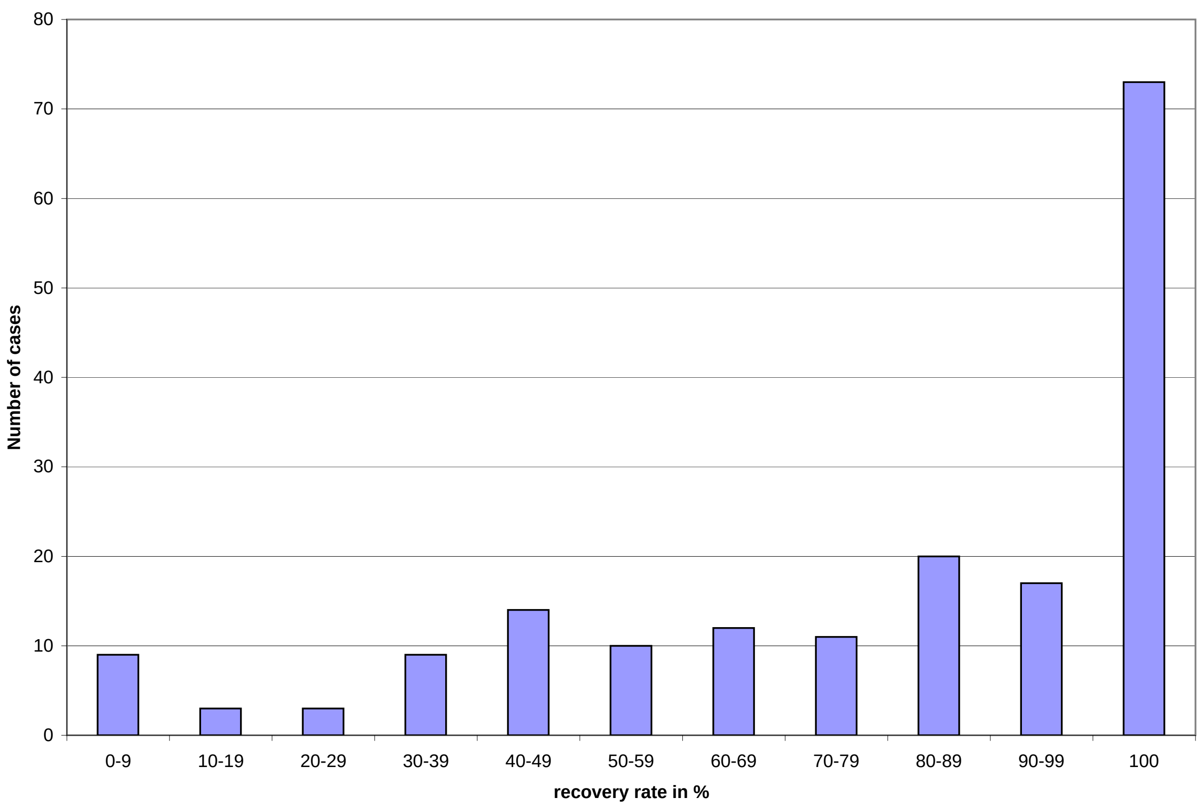

Table 1
Characteristics of the sample of 260 firms filing for bankruptcy in Sweden, 1988-1991

		Total sample	Prepack filing	Going-concern sale	Piecemeal liquidation
A: Distribution of sample firms across industries					
Manufacturing		81	13	50	18
Construction		37	7	22	8
Transport		28	3	13	12
Trade and retail of goods		45	15	23	7
Hotels and restaurants		28	9	12	7
Services		41	6	27	8
Total		260	53	147	60
B: Firm financial characteristics and CEO ownership[a]					
Total assets ($ million)	Mean	2.3	2.6	2.2	2.2
	Median	1.2	1.4	1.1	1.1
Sales ($ million)	Mean	4.7	6.2	4.1	4.7
	Median	2.5	2.7	2.5	2.2
Number of employees	Mean	43	47	44	36
	Median	29	28	29	29
EBITDA/sales (%)	Mean	-0.2%	0.3%	0.2%	-1.7%
	Median	1.8%	1.7%	1.7%	2.3%
Debt/assets	Mean	0.92	0.88	0.94	0.94
	Median	0.93	0.92	0.93	0.95
CEO equity ownership (%)	Mean	60%	66%	56%	63%
	Median	72%	100%	60%	81%

[a]The financial data is from the last financial statement reported prior to filing. CEO ownership is from the bankruptcy filing documents.

Table 2
Bidder interest, bank financing, premiums and recovery rates

		Total sample[a]	Prepack filing[b]	Going-concern sale	Piecemeal liquidation
A: Auction demand					
Multiple buyers expressing an interest in placing a bid	Number	98	5	77	16
	Total	195	33	102	20
	Percent	50%	15%	75%	80%
Bankrupt firm's bank financing the winning bidder	Number	64	20	44	
	Total	130	35	95	n/a
	Percent	49%	57%	46%	
B: Premiums and recovery rates					
Auction premium $(p-1)^c$	Average	94%		125%	8%
	Std error	18%	n/a	24%	8%
	N	175		130	45
Bank liquidation recovery rate $(r)^d$	Average	0.60		0.66	0.45
	Median	0.68	n/a	0.77	0.39
	Std error	0.03		0.03	0.05
	N	196		141	55
Bank realized recovery rate[e]	Average	0.69	0.77	0.76	0.46
	Median	0.83	0.91	0.89	0.40
	Std error	0.02	0.05	0.02	0.05
	N	236	40	141	55

[a]Sample of 260 firms filing for bankruptcy in Sweden, 1988-1991.

[b]In prepacks, the trustee typically does not report a piecemeal liquidation value estimate, hence the missing information on the auction premium and the bank liquidation recovery rate.

[c]The auction premium is the price paid by the winning bidder in excess of the trustee's piecemeal liquidation value estimate l^a of the auctioned assets. If the auction excludes some liquid assets (such as cash balances, accounts receivables and real estate), then $l^a < l$, where l is the trustee's estimate of the total piecemeal liquidation value of the bankrupt firm's assets.

[d]The liquidation recovery rate r is the bank's recovery rate on its debt if the winning bidder pays the trustee's piecemeal liquidation value estimate l. Specifically, $r = min[(l-s)/f, 1]$, where f is the face value of the bank's debt and s is the face value of all debt senior to the bank.

[e]Realized payoff to the bank divided by the face value of its claim f on the bankrupt firm.

Table 3
Definitions of variables used in cross-sectional regressions for overbidding

Variable name	Definition
A: Variables for direct tests of overbidding	
p	Auction premium: the price paid in the auction divided by the trustee's estimate of the piecemeal liquidation value l^a of the auctioned assets.[a] The auction determines p.
r	Bank's liquidation recovery rate: $r = min[(l - s)/f, 1]$, where f is the face value of the bank's debt and s is the face value of any debt senior to the bank. r is the bank's debt recovery obtained in the event that the bankruptcy proceeds equal l, the trustee's estimate of the firm's total piecemeal liquidation value. $r < 1$ implies incentive to overbid.
r^*	$r^* = (l - s)/f$ for $r = 1$, and $r^* = 0$ for $r < 1$. $r^* \geq 1$ implies no incentive to overbid
r_{low}	Indicates that $0 < r \leq 0.5$, which implies incentives to overbid.
r_{high}	Indicates that $r = 1$, which implies no incentives to overbid.
B: Controls for firm characteristics[b]	
$Size$	Log of the book value of pre-filing assets.
$Profit\ margin$	Difference between the firm's pre-filing operating margin (EBITDA/sales) and the industry median operating margin.[c]
$Tangible$	Fraction secured debt to total debt at filing, a proxy for the fraction of tangible assets.
C: Controls for auction demand	
$Piecemeal$	Binary indicator variable for the target firm being liquidated piecemeal
$Concern$	Indicator for the firm being sold as a going concern ($1 - Piecemeal$).
$Industry\ distress$	Fraction of industry firms reporting an interest coverage ratio $ICR < 1$ or file for bankruptcy the following year, where ICR=(EBITDA+interest income)/interest expense.[c]
$Saleback$	Indicator that the firm is sold as a going concern to a target insider (owner and/or manager).
$Multiple\ interest$	Indicator that more than one potential bidder express an interest in placing a bid.
$Bank$	Indicator that the bankrupt firm's bank finances the winning going concern bid.

[a]If the auction excludes some liquid assets (such as cash balances, accounts receivables, or real estate), then $l^a < l$, where l is the trustee's estimate of the total piecemeal liquidation value of the bankrupt firm's assets.

[b]Pre-filing characteristics are from the last financial statement reported prior to filing.

[c]The bankrupt firm's industry consists of all Swedish firms with at least 20 employees and that operate in the same 4-digit SIC code as the bankrupt firm.

Table 4
Regressions testing the overbidding hypothesis

OLS coefficient estimates in regressions of the auction premium $ln(p)$ on the bank's ex ante liquidation recovery rate r, where $r \equiv min[(l-s)/f, 1]$, l is the trustee's ex ante estimate of the piecemeal liquidation value, s is the face value of debt senior to the bank, and f is the face value of the bank's debt. The overbidding hypothesis predicts a negative coefficient for r. See Table 3 for remaining variable definitions. Sample of 175 Swedish firms auctioned in bankruptcy 1988-1991 and with data on p and l (p-values and degrees of freedom in parentheses).

Constant	r	$r\times$ *Piecemeal*	$r\times$ *Concern*	*Piecemeal*	*Size*	*Profit margin*	*Tangible*	Adjusted R^2	F-value	N
A: Sample of going-concern sales and piecemeal liquidations										
0.915 (0.350)	-0.900 (0.000)			-0.604 (0.000)	0.018 (0.770)	-0.303 (0.461)	-0.588 (0.055)	0.146 (df=5)	6.96 (0.000)	175
1.195 (0.219)		-0.147 (0.677)	-1.156 (0.000)	-1.152 (0.000)	0.012 (0.839)	-0.224 (0.582)	-0.633 (0.036)	0.172 (df=6)	7.03 (0.000)	175
1.195 (0.219)	-1.156 (0.000)	1.009 (0.013)		-1.152 (0.000)	0.012 (0.839)	-0.224 (0.582)	-0.633 (0.036)	0.172 (df=6)	7.03 (0.000)	175
B: Sample of going-concern sales and piecemeal liquidations where $r < 1$										
0.884 (0.459)	-0.832 (0.002)			-0.744 (0.000)	0.027 (0.722)	-0.361 (0.410)	-0.761 (0.042)	0.177 (df=5)	6.13 (0.000)	120
0.944 (0.427)		-0.225 (0.640)	-1.088 (0.001)	-1.113 (0.000)	0.032 (0.673)	-0.270 (0.539)	-0.802 (0.032)	0.187 (df=6)	5.55 (0.000)	120
0.944 (0.427)	-1.088 (0.001)	0.863 (0.134)		-1.113 (0.000)	0.032 (0.673)	-0.270 (0.539)	-0.802 (0.032)	0.187 (df=6)	5.55 (0.000)	120

Table 5
Robustness tests for the overbidding hypothesis

OLS coefficient estimates in regressions of the auction premium $ln(p)$ on the overbidding variable r and a robustness test variable r^*, where $r^* = (l - s)/f$ when $r = 1$ and $r^* = 0$ when $r < 1$. The variable r^* captures the impact on auction premiums of the cross-sectional variation in $(l - s)/f$ when there is no scope for overbidding. The overbidding hypothesis predicts a negative coefficient for r and a zero coefficient for r^*. The table also adds control variables for industry liquidity, auction demand, and a saleback to the auctioned firm's previous owner. Variable definitions are in Table 3. Sample of 175 firms auctioned in Swedish bankruptcy 1988-1991 (p-values and the degrees of freedom in parentheses).

Constant	r	r^*	*Piece–meal*	*Industry distress*	*Multiple interest*	*Saleback*	*Size*	*Profit margin*	*Tangible*	Adjusted R^2	F-value	N
A: Sample of going-concern sales and piecemeal liquidations												
1.171	-1.010	0.024	-0.617	-0.597			0.018	-0.297	-0.569	0.149	5.35	175
(0.241)	(0.000)	(0.391)	(0.000)	(0.180)			(0.777)	(0.470)	(0.063)	(df=7)	(0.000)	
B: Sample of going-concern sales												
1.770	-1.313	0.031		-0.721			-0.003	-0.532	-0.643	0.174	5.52	130
(0.126)	(0.000)	(0.264)		(0.166)			(0.966)	(0.436)	(0.070)	(df=6)	(0.000)	
2.007	-1.416	0.029		-0.801	-0.323		0.017	-0.886	-1.136	0.173	3.68	91
(0.151)	(0.000)	(0.334)		(0.212)	(0.131)		(0.839)	(0.282)	(0.014)	(df=7)	(0.002)	
1.740	-1.328	0.034		-0.840		0.226	-0.007	-0.580	-0.625	0.180	4.98	128
(0.136)	(0.000)	(0.219)		(0.118)		(0.119)	(0.921)	(0.395)	(0.080)	(df=7)	(0.000)	
C: Sample of going concern sales where $r = 1$												
1.289		0.040		-0.911			-0.070	0.586	0.060	-0.028	0.74	48
(0.500)		(0.172)		(0.317)			(0.562)	(0.775)	(0.927)	(df=5)	(0.594)	
D: Sample of piecemeal liquidations												
-0.604	-0.126			-0.036			0.050	-0.075	-0.541	-0.104	0.17	45
(0.758)	(0.755)			(0.967)			(0.690)	(0.890)	(0.378)	(df=5)	(0.973)	

Table 6

Tests for overbidding after orthogonalizing the liquidation recovery rate r and the piecemeal liquidation value l

OLS coefficient estimates in regressions of the auction premium $ln(p)$ on r_ϵ. By construction, the variable r_ϵ is orthogonal to $ln(l)$ as it is the residual from the following regression: $r = \gamma_0 + \gamma_1 ln(l) + r_\epsilon$. The overbidding hypothesis predicts a negative coefficient on r_ϵ. Variable definitions are in Table 3. Sample of 175 Swedish firms auctioned in bankruptcy 1988-1991 (p-values and the degrees of freedom in parentheses).

Constant	r_ϵ	*Piece–meal*	*Industry distress*	*Multiple interest*	*Saleback*	*Size*	*Profit margin*	*Tangible*	Adjusted R^2	F-value	N
A: Sample of going-concern sales and piecemeal liquidations											
2.016	-1.042	-0.542				-0.083	-0.258	-0.713	0.131	6.23	175
(0.059)	(0.000)	(0.000)				(0.211)	-(0.534)	(0.028)	(df=5)	(0.000)	
2.275	-1.088	-0.557	-0.483			-0.089	-0.246	-0.716	0.132	5.39	175
(0.038)	(0.000)	(0.000)	(0.279)			(0.183)	(0.553)	(0.027)	(df=6)	(0.000)	
B: Sample of going-concern sales											
2.813	-1.316					-0.130	-0.338	-0.801	0.134	5.97	130
(0.026)	(0.000)					(0.096)	(0.627)	(0.034)	(df=4)	(0.000)	
3.138	-1.359		-0.613			-0.137	-0.400	-0.787	0.136	5.06	130
(0.015)	(0.000)		(0.247)			(0.079)	(0.566)	(0.038)	(df=4)	(0.000)	
3.440	-1.483		-0.673	-0.348		-0.125	-0.690	-1.244	0.139	3.41	91
(0.031)	(0.000)		(0.300)	(0.109)		(0.192)	(0.410)	(0.012)	(df=6)	(0.005)	
3.133	-1.373		-0.716		0.221	-0.143	-0.448	-0.788	0.142	4.50	128
(0.016)	(0.000)		(0.190)		(0.136)	(0.070)	(0.519)	(0.039)	(df=6)	(0.000)	
C: Sample of piecemeal liquidations											
-0.449	-0.151					0.036	-0.076	-0.566	-0.077	0.21	45
(0.824)	(0.760)					(0.779)	(0.884)	(0.372)	(df=4)	(0.930)	
-0.443	-0.153		-0.014			0.036	-0.075	-0.567	-0.105	0.16	45
(0.831)	(0.769)		(0.987)			(0.782)	(0.889)	(0.381)	(df=5)	0.974)	

Table 7

Regressions for overbidding with correction for self-selection of auction prepack filing

WLS coefficient estimates in regressions of the auction premium $ln(p)$ on r and the inverse Mill's ratio $\frac{\phi(\gamma' Z)}{\Phi(\gamma' Z)}$ from the probit model $\gamma' Z$ for the choice of a regular (nonprepack) filing. Z contains the variables *Industry distress*, *Size*, *Profit margin*, and *Tangible*, and a constant, and ϕ_i and Φ_i are the standard normal density and cumulative normal distribution functions, respectively, evaluated at $\gamma' Z$. The remaining variables are defined in Table 3. Sample of 175 Swedish firms filing for bankruptcy 1988-1991 (p-values and the degrees of freedom are in parentheses).

Constant	r	*Piece–meal*	*Multiple interest*	*Saleback*	*Size*	*Profit margin*	*Tangible*	$\frac{\phi(\gamma' Z)}{\Phi(\gamma' Z)}$	Adjusted R^2	F-value	N
A: Sample of going-concern sales and piecemeal liquidations											
-0.191 (0.879)	-0.834 (0.000)	-0.537 (0.000)			0.245 (0.188)	0.341 (0.520)	-2.766 (0.122)	-4.332 (0.186)	0.114 (df=6)	4.71 (0.000)	175
B: Sample of going-concern sales											
-0.236 (0.928)	-1.202 (0.000)				0.259 (0.484)	-0.713 (0.336)	-2.753 (0.353)	-3.495 (0.468)	0.169 (df=5)	6.24 (0.000)	130
2.779 (0.209)	-1.262 (0.000)		-0.291 (0.178)		-0.175 (0.625)	-0.503 (0.604)	0.408 (0.894)	2.244 (0.618)	0.159 (df=6)	3.87 (0.002)	91
-0.416 (0.854)	-1.189 (0.000)			0.180 (0.214)	0.360 (0.352)	-0.669 (0.353)	-3.964 (0.248)	-5.643 (0.326)	0.164 (df=6)	5.16 (0.000)	128

Table 8
Overbidding tests assuming non-linear bidding functions

The table uses a Box-Cox transformation $r^{(\lambda)}$ of r defined as

$$r^{(\lambda)} = \begin{cases} (r^{\lambda} - 1)/\lambda & \text{for } \lambda \neq 0 \\ \ln r & \text{for } \lambda = 0. \end{cases}$$

Our estimate of λ is 1.53 with a p-value of 0.69. This estimate is indistinguishable from one (linearity) and from zero. The table reports OLS coefficient estimates for the auction premium $ln(p)$ with the overbidding variable r transformed using $\lambda = 1.53$ (Panel A) and $\lambda = 0$ (Panel B and C). Sample of 124 firms auctioned in Swedish bankruptcy 1988-1991 with a liquidation recovery rate $r < 1$. Variable definitions are in Table 3. p-values and the degrees of freedom are in parentheses.

Constant	$r^{(\lambda)}$	*Size*	*Profit margin*	*Tangible*	Adjusted R^2	F-value	N
A: Box-Cox transformation of r using $\lambda = 1.53$. Sample of going-concern auctions with $r < 1$							
0.090	-1.478	0.031	0.426	-1.123	0.184	4.28	80
(0.950)	(0.000)	(0.738)	(0.665)	(0.013)	(df=4)	(0.004)	
B: Box-Cox transformation of r using $\lambda = 0$. Sample of going-concern auctions with $r < 1$							
-0.692	-0.346	0.093	-0.321	-1.310	0.146	4.24	76
(0.638)	(0.001)	(0.322)	(0.747)	(0.004)	(df=4)	(0.004)	
C: Box-Cox transformation of r using $\lambda = 0$. Sample of piecemeal liquidations with $r < 1$							
-0.620	-0.124	0.050	-0.103	-0.542	-0.076	0.22	44
(0.746)	(0.741)	(0.686)	(0.842)	(0.368)	(df=4)	(0.926)	

Table 9
Industry-adjusted post-bankruptcy operating performance and leverage

The table reports operating margins and debt ratios for firms auctioned as going concerns in bankruptcy, classified by the level of the bank's liquidation recovery rate r and whether the bankrupt firm's bank finances the winning bidder. "Industry-adjusted" is the difference between the target firm's value and the corresponding median value for the target's 4-digit SIC industry. "Year 1" is the first calendar year after auction bankruptcy, etc. Superscript ** (*) indicates that the sample median is different from the industry median at the 1% (5%) level, using a Wilcoxon signed ranks test. The p-value for the difference in industry-adjusted performance and debt medians is from a 2-sided Mann-Whitney U-test. Variable definitions are in Table 3. Sample of 106 Swedish firms sold as going-concerns in auction bankruptcy during 1988-1991.

Year after bankruptcy:		1	2	3	4
A: Industry-adjusted operating margin (EBDITA/sales)					
$r_{high} = 1$	Median	-0.004	-0.012	-0.011	0.018
	n	35	28	23	16
$r_{low} = 1$	Median	-0.005	-0.017	0.004	0.018
	n	24	21	14	13
Difference: r_{high} vs. r_{low}		0.001	0.005	-0.015	0.000
		(0.963)	(0.840)	(0.639)	(0.930)
$Bank = 1$	Median	-0.009	-0.010	-0.008	0.020
	n	36	29	23	20
$Bank = 0$	Median	0.014	-0.018	-0.001	0.040
	n	42	39	30	19
Difference: $Bank = 1$ vs. $Bank = 0$		-0.023	0.008	-0.007	-0.020
		(0.183)	(0.548)	(0.693)	(0.448)
$r_{high} = 1$ and $Bank = 1$	Median	-0.027	-0.034*	-0.032	0.019
	n	16	11	9	5
$r_{low} = 1$ and $Bank = 1$	Median	0.100	0.062	0.008	0.022
	n	7	6	4	5
Difference: r_{high} vs. r_{low} | $Bank = 1$		-0.128	-0.096	-0.040	-0.003
		(0.038)	(0.016)	(0.355)	(0.754)
B: Industry-adjusted debt ratio (book value of debt/total assets)					
$r_{high} = 1$	Median	0.114*	0.079*	0.004	0.026
	n	27	23	19	13
$r_{low} = 1$	Median	0.121**	0.069*	0.143	0.136**
	n	24	21	15	13
Difference: r_{high} vs. r_{low}		-0.010	0.010	-0.139	-0.110
		(0.610)	(0.934)	(0.591)	(0.144)
$Bank = 1$	Median	0.132**	0.100**	0.090	0.062
	n	36	28	23	20
$Bank = 0$	Median	0.112*	0.073*	0.151	0.026
	n	42	40	32	19
Difference: $Bank = 1$ vs. $Bank = 0$		0.020	0.027	-0.061	0.036
		(0.568)	(0.794)	(0.621)	(0.482)
$r_{high} = 1$ and $Bank = 1$	Median	0.145**	0.140**	0.097	0.083
	n	16	11	9	5
$r_{low} = 1$ and $Bank = 1$	Median	0.089	0.052	0.012	0.068
	n	7	6	4	5
Difference: r_{high} vs. r_{low} | $Bank = 1$		0.056	0.088	0.085	0.014
		(0.316)	(0.191)	(0.537)	(0.754)

Table 10
Bankruptcy refiling probability for targets sold as going-concern

Coefficients in logit estimations of the probability that the surviving firm refiles for bankruptcy within 2 years of the auction. The variables are defined in Table 3. The sample is 106 Swedish firms sold as going-concerns in auction bankruptcy 1988-1991. P-values are in parentheses.

Constant	r	r^*	r_{low}	r_{high}	*Industry distress*	*Saleback*	*Bank*	*Size*	*Profit margin*	*Tangible*	Cox Snell R^2	χ^2	n
1.21 (0.776)	0.29 (0.695)							-0.15 (0.568)	2.59 (0.339)	-0.35 (0.785)	0.02	1.74 (0.783)	106
0.94 (0.826)	0.50 (0.537)	-0.09 (0.582)						-0.14 (0.608)	2.63 (0.331)	-0.41 (0.757)	0.02	2.16 (0.826)	106
1.92 (0.665)	0.24 (0.773)	-0.07 (0.669)			-2.51 (0.182)			-0.14 (0.600)	2.56 (0.340)	-0.19 (0.885)	0.04	3.99 (0.677)	106
1.75 (0.679)			0.68 (0.296)	0.58 (0.365)	-2.74 (0.140)			-0.15 (0.573)	2.64 (0.329)	-0.21 (0.868)	0.05	5.07 (0.534)	106
0.72 (0.868)			0.76 (0.253)	0.60 (0.353)	-3.44 (0.078)	0.83 (0.162)		-0.12 (0.670)	1.63 (0.580)	-0.05 (0.946)	0.07	7.16 (0.413)	106
1.03 (0.839)	-0.48 (0.635)	0.17 (0.539)			-3.54 (0.113)		2.22 (0.001)	-0.19 (0.557)	-0.40 (0.895)	1.89 (0.274)	0.16	15.37 (0.031)	85
-0.28 (0.955)			1.07 (0.195)	0.70 (0.395)	-3.37 (0.118)		2.17 (0.002)	-0.14 (0.639)	-0.13 (0.964)	1.29 (0.432)	0.18	16.81 (0.019)	85
-0.35 (0.947)	-0.37 (0.688)				-4.50 (0.058)	1.09 (0.128)	2.24 (0.002)	-0.14 (0.672)	-1.88 (0.594)	2.21 (0.196)	0.19	17.67 (0.014)	84
0.36 (0.951)					-3.26 (0.119)		2.14 (0.002)	-0.15 (0.628)	-0.17 (0.955)	1.66 (0.296)	0.16	14.98 (0.010)	85