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ABSTRACT

Bidding in Mandatory Bankruptcy Auctions: Theory and Evidence*

We analyse bidding incentives and present evidence on takeover premiums in Sweden's mandatory bankruptcy auctions. The typical auction attracts multiple bidders and results in the firm being sold as a going concern. We model the incentive of the bankrupt firm's main creditor (a bank) to influence the auction outcome. Rules prevent the bank from bidding directly. However, the bank often finances a bidder in the auction, relaxing liquidity constraints. We show that the optimal bid strategy for a bank-bidder coalition mimics the monopolist sales price. In the region where the bank's debt is impaired, this optimal bid exceeds the private valuation of the bank's coalition partner (overbidding). We derive new and testable cross-sectional predictions of the overbidding theory, and provide empirical support using auction premiums as dependent variable. Interestingly, there is no evidence that the auctions produce lower (fire-sale) premiums when economic conditions lead one to expect relatively low intra-industry auction demand. Moreover, premiums in transactions where insiders repurchase the firm (salebacks) are on average indistinguishable from premiums in sales to company outsiders, which fails to support self-dealing arguments. Overall, the evidence is consistent with the average auction producing a relatively efficient allocation of the bankrupt firm

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1 Introduction

In Sweden, a firm filing for bankruptcy is turned over to a court-appointed trustee who automatically puts the firm up for sale in an open auction. The mandatory auction system has an attractive simplicity. Bids may be for each individual asset (piecemeal liquidation) or for the entire firm as a going concern. Payment must be in cash, allowing the auction proceeds to be distributed to creditors strictly according to absolute priority. Cash constrained bidders often finance the bid using the auctioned firm's assets as collateral, much as in a leveraged buyout (LBO) transaction. In going-concern sales, the buyer typically renegotiates labor contracts to maintain the firm's operations.[1] The auctions are quick (lasting an average of only two months), relatively cost-efficient, and three-quarters of the filing firms survive the auction as a going concern (Thorburn (2000)). Following the auction, firms restructured as going concerns tend to perform at par with non-bankrupt industry rivals (Eckbo and Thorburn (2003)).[2]

Despite its apparent effectiveness, the idea of a mandatory bankruptcy auction system is unpopular throughout much of Western Europe and the US. In the context of recent European Union bankruptcy reforms, Hart (2000) observes "I'm not aware of any group–management, shareholders, creditors, or workers–who is pushing for cash auctions". In the US, firms are occasionally auctioned out of Chapter 11 (Hotchkiss and Mooradian (1998)). However, the acquisition procedure is not standardized and can be fraught with administrative inefficiencies.[3] Also, there is a concern that the hard constraint on management implied by a mandatory auction system induces inefficient managerial project selection to ward off bankruptcy.[4] The argument is an application of the shareholder risk-shifting incentives originally analyzed in Jensen and Meckling (1976).[5] In Eckbo and Thorburn (2003), we counter the risk-shifting argument by including in the managerial objective function the preservation of firm-specific private benefits of control. Preserving control benefits requires survival of the firm and thus may induce a more conservative (less risky) prefiling

[1]Eckbo and Thorburn (2003) find that one-third of the incumbent managers are rehired by the buyer.

[2]hThis survival rate is similar to what is reported for Chapter 11 reorganizations. See, e.g., White (1984), Franks and Torous (1989), Weiss (1990), and LoPucki and Whitford (1993). The post-bankruptcy performance result, however, contrasts with Chapter 11 evidence where, e.g., Hotchkiss (1995) finds that restructured firms tend to underperform their respective industries.

[3]A recent example is the acquisition by American Airlines of a bankrupt TWA in early 2001 (Eckbo (2001)).

[4]See, e.g., Aghion, Hart, and Moore (1992), White (1996), and Franks, Nyborg, and Torous (1996).

[5]Berkovitch, Israel, and Zender (1997) also argue that an automatic auction system may lead to managerial underinvestment in firm-specific human capital.

managerial investment policy than what is preferred by shareholders. The evidence of high survival rates and post-bankruptcy performance runs counter to the risk-shifting argument and is consistent with managerial conservatism prior to bankruptcy filing.

In this paper, we focus on concerns with market liquidity, competition, and self-dealing in the mandatory bankruptcy auctions. Shleifer and Vishny (1992) and Aghion, Hart, and Moore (1992) warn that bankruptcy auctions may result in fire-sale prices if they coincide with industry-wide financial distress. Moreover, Strömberg (2000) models creditor incentives to preempt the auction by putting the bankrupt firm back to its former owners (a saleback) at terms which are detrimental to junior creditors. If these concerns are empirically valid, investors have reason to favor structured bargaining over auctions. We are the first to present direct tests of the fire-sale and self-dealing hypotheses using data on auction premiums.[6] Moreover, we develop and test a theoretical model which suggests that the scope for fire-sales in bankruptcy auctions may be countered by the bidding incentives of the bankrupt firm's main creditor (the bank). A key empirical issue is therefore whether the bank's incentives are sufficiently strong to counter self-dealing and fire-sale tendencies.

Our theoretical analysis starts with the observation that, under Swedish rules, the bank can neither present itself as a bidder in the auction nor can it overrule a decision by the trustee to sell to the highest bidder. Thus, although the bank is the main residual claimant, it cannot directly influence the winning price. However, our data shows that the bank often finances a bidder, and we derive an incentive-compatible bid strategy for the bank-bidder coalition. The coalition's optimal bid exceeds the private valuation of the bank's coalition partner (overbidding).[7] Overbidding transfers wealth from bidders other than the coalition partner and thus leaves the bank better off relative to remaining a passive bystander to the auction. We show that the optimal coalition bid mimics a monopolist seller's take-it-or-leave-it offer, in effect getting around the institutional constraint on direct bank bidding.

Our empirical analysis begins by showing that the typical auction is quite active. On average, four bidders submit competing bids, and another two contemplates entering the auction after registering serious interest with the auctioneer. Before approving a saleback, the auction rules

[6] The extant empirical literature on fire sales focuses primarily on individual asset sales of financially distressed or bankrupt US firms. See, e.g., Pulvino (1998) and Maksimovic and Phillips (1998).

[7] Overbidding incentives are also discussed in Burkart (1995), Singh (1998), Bulow, Huang, and Klemperer (1999), Betton and Eckbo (2000), Hotchkiss and Mooradian (2003), and Betton, Eckbo, and Thorburn (2004).

require the auctioneer to actively search for competing bids. Perhaps as a consequence, the average premium in salebacks is no less than the average premium in going-concern sales to company outsiders. Also, the incidence of bank financing of the winning bidder is about the same for salebacks as for sales to outside investors. The lack of a bank-preference for financing salebacks runs counter to a key model assumption of Strömberg (2000). Moreover, his conjecture that salebacks are fraught with conflicts of interest between the bank and junior creditors is not supported by our auction premium evidence.

We then proceed to use our bid premium data to perform cross-sectional tests of the overbidding theory. The overbidding theory predicts that the expected going-concern premium (defined as the final auction price relative to an estimate of the value of the firm's assets if liquidated piecemeal) increases in the degree of impairment of the bank's debt. In other words, the greater the distance between the firm's ex ante piecemeal liquidation value and full recovery by the bank, the greater the bank's incentive to "assist" the auction by financing a bidder and induce overbidding. The regression results support this prediction for the sample of auctions resulting in going-concern sale. Also as predicted, there is no evidence of overbidding in the sub-sample auctions resulting in piecemeal liquidations. In sum, the empirical results are consistent with overbidding incentives being played out in the auction whenever bidders acquire the bankrupt firm as a going concern.

We then use our auction premium data to examine the asset fire-sale argument of Shleifer and Vishny (1992) and Aghion, Hart, and Moore (1992).[8] We add variables designed to capture fire-sale conditions, such as the degree of industry-wide financial distress, business cycle change, and the number of bids. We find no evidence that the going-concern premium depends on these variables. There is also no indication that the trustee's ex ante piecemeal liquidation value estimate itself depends on fire-sale conditions. Correcting for a possible selection bias from auction prepacks does not alter our conclusions with respect to either the fire-sale argument or the overbidding theory. It appears from the data that theoretical warnings of fire-sales in a bankruptcy system with automatic auctions may be overstated.[9] Prior work has ignored the liquidity-enhancing role of the bank, and

[8] Aghion, Hart, and Moore (1992) warn that the all-cash requirement per se restricts bids in the auction. However, this ignores the fact that bidders may—and typically do—finance bids using the auctioned firm's assets as collateral, much as in a leveraged buyout (LBO) transaction in the US. The LBO mechanism relaxes the constraint imposed by the all-cash payment restriction under the auction rules

[9] "We agree.. that the policy of automatic auctions for the assets of distressed firms, without the possibility of Chapter 11 protection, is not theoretically sound" (Shleifer and Vishny, 1992, p.1344).

it may be that the extensive bid-financing by the old bank plays an empirically important role in countering asset-fire sale tendencies in these auctions.

Finally, we examine salebacks in more detail. Comparing salebacks with going-concern sales to company outsiders, we show that salebacks occur independently of industry-wide distress and are significantly more likely to occur when the economy is in a business cycle upturn. This contradicts the conclusion of Strömberg (2000) that salebacks are more likely when markets are relatively illiquid. We show that his conclusion is the result of pooling samples of piecemeal liquidations and going-concern sales. As it turns out, *all* going-concern sales—also those to company outsiders—take place during better business cycle conditions than piecemeal liquidations. Since salebacks tend to occur under more favorable market conditions than even other going-concern sales, the proposition that salebacks represent a response by company insiders to fire-sale conditions is not supported by the data. Overall, the data also does not support a self-dealing argument for salebacks.

The rest of the paper is organized as follows. Section 2 briefly describes key aspects of the Swedish auction bankruptcy system. We develop our theoretical bidding results and the associated testable implications in Section 3. Section 4 present evidence on the degree of auction competition, and shows average auction premiums and recovery rates. Section 5 presents the paper's tests of the overbidding hypothesis, while the effects of fire-sale conditions and potential conflicts of interest are examined in Section 6. Section 7 discusses issues concerning the economic efficiency of automatic bankruptcy auctions, while Section 8 concludes the paper.

2 The Swedish auction bankruptcy system

The Swedish mandatory auction bankruptcy system is a hybrid between the bankruptcy codes in the UK and the US. As in the UK, court-supervised debt renegotiation is not an option, which makes the system more contract-driven than the structured bargaining environment dictated by Chapter 11 in the US. As in the US, the Swedish code restricts the liquidation rights of creditors: A bankruptcy filing triggers an automatic stay of debt payments and prevents repossession of collateral. These provisions help protect the firm as a going concern throughout the bankruptcy process.[10] However, while managers in the US retain substantial control rights in bankruptcy, the

[10]In contrast, the UK has a contract-driven receivership system where creditor rights are enforced almost to the letter. Here, assets pledged as collateral can be repossessed even if they are vital for the firm, and there is no stay of

Swedish bankruptcy system automatically terminates labor contracts and auctions off the firm. The bidders in this auction determine whether the firm is economically viable as a restructured going concern or whether the firm's assets are to be liquidated piecemeal.

Table 1 summarizes key legal rules in Sweden with a brief comparison to Chapter 11. For a bankruptcy petition to be approved by the court, the firm has to be insolvent, defined as a non-temporary inability to pay its debt obligations.[11] Following filing approval, control of the firm passes to an independent, court-appointed trustee with fiduciary responsibility to creditors.

The trustee's main task is to organize the sale of the firm in an open, cash-only auction. Trustees are judged by supervisory agencies and major creditors for their ability to hold a proper, arms-length auction procedure.[12] Before accepting a saleback proposal, the trustee is required to make a substantial search effort for competing bids. Auction bids may be for individual assets (piecemeal liquidation) or for the firm as a going concern.

A going-concern sale takes place by merging the assets and operations of the firm into a receiving company owned by the buyer, much like a leveraged buyout transaction in the US. The firm's assets are transferred to the buyout firm while the debt claims remain on the books of the bankrupt firm. The availability of this debt financing mechanism means that the all-cash requirement of the auction is unlikely to represent a binding constraint for the buyer. Since the firm is sold in an auction, there is no need for a system of creditor voting: creditors simply receive the cash proceeds from the auction which is distributed strictly according to absolute priority.

As in the US, bankruptcy filing triggers a stay of all creditors, and it is in principle possible to raise super-priority debt to finance the firm's ongoing activities until the final sale. Given the relatively short time to final sale (on average 2 months), there is in practice little demand for such financing.[13] Bankrupt firms tend to cover operating expenses by increasing their debt obligations in the form of trade credits that get super-priority During the auction, workers and the old management team remain temporarily with the firm to keep operations running. There is a

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debt claims. This makes it difficult to continue to operate the distressed firm under receivership.

[11]If the firm files the petition, insolvency is presumed and the filing approved automatically. If a creditor files, insolvency must be proven before the firm can enter bankruptcy, a process that takes on average two months. In our sample below, about 90% of the filings are debtor-initiated. The bank sometimes forces the firm to file by cancelling the firm's credit line.

[12]Trustees are certified and licensed by a government supervisory authority ("Tillsynsmyndigheten i Konkurs" or TSM), which also reviews the trustees' compensation and performance. Trustees are compensated on an hourly basis.

[13]For evidence on debtor-in-possession financing under Chapter 11, see Dahiya, John, Puri, and Ramirez (2003).

limited government wage guarantee.[14]

The Swedish bankruptcy system allows firms to file a ”prepackaged” going-concern sale of the firm (henceforth ”auction prepack”). Auction prepack negotiations are typically initiated by the owner-manager and is subject to approval by secured creditors. Since the firm remains insolvent following the prepack sale (the cash proceeds from the sale are necessarily less than the face value of outstanding debt), it must file for bankruptcy. Prepackaged asset sale is typically completed the day before–or on the day of–the bankruptcy filing. The role of the bankruptcy court in this instance is primarily to check for conflicts of interest, and to allow junior creditors to object to the sale. If the sale is approved, the bidder pays the contractually agreed prepack price. If the sale is overturned, the contract is voided and the trustee implements the open auction. If so, the prepack bidder may participate in the auction. However, auction prepack filings are almost never overturned. Thorburn (2000) shows that prepacks have significantly lower direct costs than a regular bankruptcy filing.

Swedish bankruptcy law has a provision for ”composition”, i.e., a procedure for renegotiating *unsecured* debt claims. However, for the court to accept a composition, secured debt and priority claims (taxes, wages, etc.) must be offered full repayment and junior creditors at least 25% of their claim. Thus, one suspects composition to be largely irrelevant, which is confirmed by the population data in Eckbo and Thorburn (2004). Starting with 1,600 financially distressed firms, they find only four cases where the firm made a successful composition attempt.

Private Swedish firms typically have a single banking relationship, and most of this bank debt is secured (average 94%, median 100% at filing). Overall, the bank is the firm's major creditor (debt claims senior to the bank average less than one percent of total debt) and alone in its creditor class. Thus, the bank is in reality a monopolist seller of the bankrupt firm. This fact notwithstanding, Swedish law prohibits the bank from formally controlling the selling process. For example, it cannot place direct bids, nor can it refuse to sell to the highest bidder. Thus, the bank cannot directly enforce a minimum sales price. However, the theory below shows that the bank may be in a position to substantially influence the final auction price through a coalition with one of the bidders, potentially getting around the institutional constraint on direct bidding.

[14]The guarantee is applicable to unpaid wages for up to six months prior to bankruptcy filing, as well as up to six months following filing depending on the employee's time with the firm. During the sample period of this paper, the maximum guarantee was capped at approximately $55,000 per employee.

3 A theory of bank-coalition bidding

In this section, we derive incentive-compatible bid strategies for a coalition between the bank and a bidder in the auction. The Swedish bankruptcy code mandates an auction. Auctions are of the open first-price (English) type, and we use the sealed-bid second-price analogy for theoretical tractability. Assuming zero bidding costs, risk neutrality, and unaffiliated private bidder valuations, the sealed-bid second-price auction is revenue-equivalent to the open first-price auction (Klemperer (2000)). Given zero bidding costs, we abstract from preemptive bidding strategies (Fishman (1988)), and we assume the presence of two (non-bank) bidders in the auction. Our main theoretical results also presume that the bank learns the coalition partner's valuation of the bankrupt firm. This is a standard assumption in the literature on reorganizations, e.g., Bulow and Shoven (1978), Brown (1989), Gertner and Scharfstein (1991), Strömberg (2000), and Hotchkiss and Mooradian (2003).

3.1 Coalition bid strategy

As indicated above, a going-concern sale takes place by merging the assets and operations of the auctioned firm into a corporate shell owned by the bidder. Swedish banking regulations prevent banks from being beneficiary owners (shareholders) of non-financial companies. Thus, the bank cannot hold shares in the shell company, nor can it bid directly for the bankrupt firm. However, there are no regulatory restrictions on the bank's ability to issue debt. Suppose the bank contacts Bidder 1 and offers to provide a loan to the shell company if the merger takes place (i.e., if Bidder 1 wins the auction). As a precondition for the loan, the bank demands a coalition bid agreement. The agreement requires a bidding strategy that maximizes the joint surplus of the bank-bidder coalition. We show below that this bid strategy is costly for the bidder, and the agreement therefore also requires a compensating transfer from the bank to the bidder. The transfer is priced into the terms of the loan.

The notation is as follows. The bank holds a senior debt claim with face value B on the bankrupt firm. Bidder i's total valuation of the auctioned firm is $V_i \equiv V_L + v_i,\ i = 1, 2$. The valuation component V_L is a constant that is common across bidders and it represents the firm's piecemeal liquidation value. The bidder-specific valuation component $v_i \in [0, 1]$ is private information and realized only if the firm is sold intact as a going concern. Assume that v_i is distributed i.i.d.

with distribution and density functions $G(v_i)$ and $g(v_i)$, respectively. The auction determines the going-concern premium $P - V_L$, i.e. the price in excess of V_L to be paid for the bankrupt firm as a going concern. We first characterize optimal bidding strategies assuming $V_L = 0$ (Proposition 1), and then show how the optimal strategy varies with V_L/B, which generates the key cross-sectional implications of the theory (Proposition 2).

The coalition agreement consists of a minimum transfer payment $T(v_1)$ from the bank to Bidder 1 in return for a coalition bid of $p_c(v_1)$. As stated in Proposition 1, if $B > v_1$ the coalition optimally overbids ($p_c(v_1) > v_1$):

Proposition 1 (Coalition bidding): *Let $V_L = 0$ and suppose the bank is the bankrupt firm's only senior creditor, holding a debt claim with face value B. The following represents an incentive-compatible coalition bid strategy:*

$$p_c(v_1) = \begin{cases} v_1 + h(p_c) & if \quad v_1 \leq B - h(p_c) & (unconstrained\ overbidding) \\ B & if \quad B - h(p_c) < v_1 < B & (constrained\ overbidding) \\ v_1 & if \quad v_1 \geq B, & (no\ coalition\ and\ no\ overbidding) \end{cases}$$

where $h(v) \equiv [1 - G(v)]/g(v)$. Moreover, the bank commits to making a transfer of minimum $T(v_1)$ to Bidder 1 following the outcome of the auction, where:

$$T(v_1) = \begin{cases} p_2 - v_1 & if \quad v_1 < p_2 \leq p_c & (coalition\ wins\ and\ pays\ p_2 > v_1) \\ 0 & if \quad p_2 \leq v_1 \leq p_c & (coalition\ wins\ and\ pays\ p_2 \leq v_1) \\ 0 & if \quad v_1 \leq p_c < p_2 & (coalition\ loses\ to\ Bidder\ 2) \end{cases}$$

Proof: The proof involves three steps. First, we derive the optimal coalition bid $p_c(v)$. Second, we show that with delegated bidding, Bidder 1 actually has an incentive to implement the optimal bid. Third, we prove that the transfer $T(v_1)$ satisfies the ex ante coalition participation constraint of both the bank and Bidder 1.

(1) The coalition bid $p_c(v_1)$: In this auction, when bidding alone, it is a dominant strategy to bid the private valuation v_i.[15] So bidder 2's strategy is always to bid $p_2 = v_2$. The coalition bids

[15] Bidding less risks foregoing v_i (with no offsetting benefit) while bidding more risks paying more than the valuation. See, e.g., Hirshleifer (1995).

p_c and receives a profit of p_c if it loses to bidder 2, and a profit of $(v_1 - p_2) + p_2 = v_1$ if it wins. Thus, the coalition's expected profit, $E(\Pi_c)$, is given by

$$E(\Pi_c) = p_c[1 - G(p_c)] + v_1 G(p_c). \tag{1}$$

The first-order condition for maximizing expected profit w.r.t $p_c(v_1)$ is

$$\frac{\partial E(\Pi_c)}{\partial p_c} = v_1 g(p_c) + [1 - G(p_c)] - p_c(v_1) g(p_c) = 0, \tag{2}$$

which, when rearranged, yields the "unconstrained overbidding" price in Proposition 1.[16]

Figure 1 illustrates the profits of the bank and Bidder 1 for the case where v_i is distributed uniform, $v_i \sim U[0,1]$. The vertical axis is bidder 2's private 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 profit without coalition formation, while area D is the expected wealth transfer from bidder 2 resulting from coalition overbidding. The expected total coalition profit is therefore $E(\Pi_c) = A + C + D$.[17]

As the senior claimant, the bank has no incentive to help generate an auction revenue that exceeds B. Figure 3 illustrates the effect of B on $p_c(v_1)$, again for the uniform case. The horizontal axis plots v_1 and the bold-faced line shows the corresponding coalition bids $p_c(v_1)$. The first segment of the bold-faced line is the unconstrained overbidding price, $p_c(v_1) = v_1 + h(p_c)$. The second (horizontal) segment is the constrained overbidding price in Proposition 1, $p_c(v_1) = B$, which occurs when $B - h(p_c) < v_1 < B$. The segment starts when v_1 is such that the unconstrained bid price equals the face value B. Throughout this segment, B caps the unconstrained overbidding price simply because the value of a bid exceeding B would represent a windfall to junior creditors. The third segment starts when $v_1 > B$. Here, every dollar overbidding is transferred directly to junior creditors, so the coalition does not overbid, $p_c(v_1) = v_1$.

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

[17] In general,

$$E(\Pi_c) = \int_0^{v_1} (v_1 - p_2) g(p_2) dp_2 + \{\int_0^{v_1} p_2 g(p_2) dp_2 + v_1[1 - G(v_1)]\} + [p_c(v_1) - v_1][1 - G(p_c)],$$

where the expression inside {} is area C. With the uniform distribution, $A + B + D = v_1^2/2 + (v_1 - v_1^2/2) + [p_c(v_1) - v_1][1 - p_c(v_1)] = v_1 + (1 - v_1)^2/4$, and the unconstrained overbidding price is $p_c(v_1) = (v_1 + 1)/2$.

(2) Delegated bidding: The transfer payment $T(v_1)$, which is conditional on the auction outcome, ensures that Bidder 1 has an incentive to bid $p_c(v_1)$ also if the bank were to completely delegate bidding to its coalition partner. When the coalition overbids and is forced to pay a price p_2 such that $v_1 < p_2 \leq p_c(v_1)$, the transfer $T(v_1)$ effectively increases Bidder 1's private valuation from v_1 to p_2. Since it is a dominant strategy to bid the private valuation, Bidder 1 will voluntarily raise its bid to p_c in this interval in order to win.[18]

(3) Coalition participation constraints: Consider first Bidder 1's incentive to participate in the coalition. Absent the transfer $T(v_1)$, overbidding provides no direct benefit to Bidder 1, only a potential cost. The cost arises when the coalition wins and pays a price greater than v_1, i.e. when the auction outcome is inefficient; $p_c(v_1) > v_2 > v_1$. In Figure 1, the expected cost of overbidding for Bidder 1 equals area E, where

$$E \equiv \int_{v_1}^{p_c(v_1)} (p_2 - v_1) g(p_2) dp_2 = \bar{T}(v_1), \tag{3}$$

and where $\bar{T}(v_1)$ denotes the expected value of the transfer payment.[19] In other words, the expected transfer $\bar{T}(v_1)$ is equal to the expected cost of overbidding. Moreover, in Figure 1, the condition for Bidder 1 being better off in the coalition than bidding alone is $A - E + \bar{T}(v_1) \geq A$, or $\bar{T}(v_1) \geq E$. Thus, as stated in the proposition, $\bar{T}(v_1)$ is the *minimum* transfer that induces Bidder 1 to participate.

Turning to the bank, it prefers coalition bidding only if its expected coalition profit, $C + D + E - \bar{T}(v_1)$, is at least as large as its expected non-coalition profit, area C in Figure 1. That is, the bank's participation constraint is $\bar{T}(v_1) \leq E + D$, which always holds for $\bar{T}(v_1) = E$. Area

[18]It is assumed that if the two bidders present identical offers, Bidder 1 is declared winner. In the second-price, sealed-bid auction, the coalition submits a bid of $p_c(v_1)$ and determines the transfer as a function of the announced auction outcome. In the case of a first-price open auction, the coalition matches p_2 until $p_2 > p_c(v_1)$, after which Bidder 1 drops out. Note that Bidder 1's optimal drop out price $p_c(v_1)$ is unaffected by the bidding in the first-price auction. To see why, suppose that bidder 2 bids s. The bid truncates the distribution of bidder 2's private values, so Bidder 1 now knows that $v_2 \geq s$. When the random variable v is truncated from below at s, the expected value conditional on s is

$$E(v_2|s) \equiv E(v_2|v_2 \geq s) = \frac{1}{1 - G(s)} \int_s^1 v_2 g(v_2) dv_2$$

Thus, we have that

$$E(\Pi_c|s) = \frac{1}{1 - G(s)} \{v_1[G(p_c) - G(s)] + p_c(v_1)[1 - G(p_c)]\},$$

which leaves the first-order condition for profit maximization (determining $p_c(v_1)$) unchanged.

[19]With the uniform distribution, $E = (1/8)(1 - v_1)^2$.

$D = [p_c(v_1) - v_1][1 - G(p_c)]$ is the expected rent extraction from bidder 2 resulting from coalition overbidding $[p_c(v_1) - v_1 > 0]$. This shows that there exist transfers $\hat{T}(v_1) > T(v_1)$ that will also induce coalition formation, as long as $E \leq \hat{T}(v_1) \leq E + D$ and $D \geq 0$. One such transfer is $T'(v_1) = p_c(v_1) - v_1$ for $v_1 < p_2 \leq p_c(v_1)$. This transfer would also induce Bidder 1 to implement the optimal coalition bid strategy on a delegated basis, but at a higher cost to the bank. In terms of Figure 1, $T'(v_1)$ would grant Bidder 1 the triangle which is the mirror image of area E and which constitutes half of the net coalition profit from overbidding. ■

Proposition 1 provides the foundation for our main empirical prediction, stated in Proposition 2, below. Let P denote the total price paid by the winning bidder in the auction, so $P - V_L$ is the actual going-concern premium paid. Moreover, define the bank's recovery rate at the piecemeal liquidation value V_L as $R_L \equiv V_L/B \in [0, 1]$. That is, R_L is the fraction of the face value recovered by the bank if there are no going-concern bids and the firm is liquidated piecemeal. B and V_L are both known at the beginning of the auction, and R_L influences the optimal coalition bid—and therefore the expected auction premium—as follows:

> **Proposition 2 (Expected auction premium):** *The coalition bid strategy of Proposition 1 implies that the expected auction premium is decreasing in the piecemeal liquidation recovery rate observed at the beginning of the auction:* $\partial E(P - V_L)/\partial R_L < 0$.

Proof: The formal proof is in Appendix A. The intuition is as follows. Recall that, if the coalition loses to bidder 2, bidder 2 is forced to pay a going-concern premium of $p_c(v_1) > v_1$. If the coalition wins, it pays an expected premium of $E(p_2|p_c(v_1)) > E(p_2|v_1)$. Thus, overbidding raises the expected auction premium, win or lose. Greater values of V_L means that the bank's debt is less impaired at the beginning of the auction, and thus the lower the incentive to overbid. The intuition for this is easily illustrated using Figure 2. The figure is drawn for $V_L = 0$, which means that the claim B is paid down using only the going-concern premium generated by the auction. That is, in Figure 2 the entire value B is at risk for the bank. The effect of increasing V_L is to reduce this risk exposure to $B' = B - V_L$ since V_L will be recovered for sure. As $B' < B$, the region for unconstrained overbidding is reduced. As a result, the expected amount of overbidding $E(p_c(v_1) - v_1)$, given by the shaded area in the figure, is also reduced. ■

3.2 Additional coalition bidding results

The bank-bidder coalition is motivated by the institutional constraint on direct auction bidding by the bank. In this section, we show that the optimal coalition bid strategy of Proposition 1 mimics the monopoly sales price in a take-it-or-leave-it offer to bidder 2. Furthermore, we show how the optimal coalition bid changes if the bank shares its debt class with other creditors, and how the bidder's incentive to participate in the coalition is affected by an existing personal loan guarantee to the bank.

> **Proposition 3:** *The following holds for the transfer $T(v_1)$ and the unconstrained overbidding price $p_c(v_1) = v_1 + h(p_c)$ defined in Proposition 1:*
>
> *(1) $p_c(v_1)$ is equal to the monopolist selling price in a take-it-or-leave-it sales offer to bidder 2.*
>
> *(2) If the bank owns a fraction $\alpha < 1$ of the debt in its priority class, the coalition price with unconstrained overbidding is $p'_c(v_1) = v_1 + \alpha h(p'_c) < p_c(v_1)$.*
>
> *(3) In a saleback coalition, the existence of a personal guarantee of the bank's debt issued by the manager/owner of the bankrupt firm reduces the minimum transfer $T(v_1)$ required for coalition overbidding.*

Proof: Starting with part (1) of the proposition, note that as a monopolist seller, the bank-bidder coalition would be asking a price p_c in a take-it-or-leave-it offer to bidder 2. Selling to bidder 2 means that Bidder 1 foregoes v_1, and so the expected opportunity cost of the monopolist seller is $v_1[1 - G(p_c)]$. The probability that bidder 2's private valuation exceeds p_c is $1 - G(p_c)$, so the monopolist's expected revenue is $p(v_1)[1 - G(p_c)]$. The expected marginal revenue is $1 - G(p_c) - p(v_1)g(p_c)$, and the expected marginal cost equals $-v_1 g(p_c)$. Equating the two yields the monopoly selling price $p_c(v_1) = v_1 + h(p_c)$. Thus, the (unconstrained) coalition bid strategy mimics that of a monopolist seller. This means that the bank achieves its (gross) revenue objective despite the institutional restriction on direct bank bidding in the auction.

In part (2), the bank's recovery is scaled with the constant α, so the coalition realizes $\alpha p'_c(v_1)$ if losing and $v_1 - p_2 + \alpha p_2$ if winning. The first-order condition for the coalition's profit maximization in Eq. (2) changes to

$$\frac{\partial E(\Pi_c')}{\partial p_c'(v_1)} = \alpha[1 - G(p_c')] - p_c'(v_1)g(p_c') + v_1 g(p_c') = 0, \tag{4}$$

which yields the optimal coalition bid stated in the proposition. This expression reproduces the optimal bid by a toehold bidder derived by Burkart (1995) in the context of corporate takeovers, where the toehold is an ownership fraction $\alpha < 1$ owned by the bidder in the target firm. In our context, the bank is effectively the residual claimant and thus has a "toehold" of $\alpha = 1$.

In small Swedish companies, it is common for the bank to demand a personal loan guarantee from the owner. This loan guarantee effectively makes the owner a residual claimant in the auction (with a concomitant reduction in the impairness of the bank's debt). Thus, as stated in part (3) of proposition 3, the loan guarantee relaxes the bidder's participation constraint, and provides the bidder with its own incentive to overbid. As a result, the loan guarantee lowers the minimum transfer $T_c(v_1)$. If the personal guarantee covers the entire value of B, then a transfer $T(v_1) = 0$ is incentive compatible for Bidder 1. ■

As stated above, our theoretical analysis presumes that v_1 is known to the bank. Suppose instead that bidders have information about their private valuations that the bank does not have. The bank now faces a screening problem. The monotonicity condition $\partial h(v)/\partial v \geq 0$ implies that the minimum transfer is decreasing in v_1.[20] As a result, Bidder 1 has an incentive to understate its true valuation (reporting $\hat{v}_1 \leq v_1$). Intuitively, bidders earn informational rents which reduces the bank's profit and incentive to form a coalition.

Given the profits from overbidding in the symmetric case, the bank has an incentive to reduce the information asymmetry, e.g., by approaching a bidder with whom it has a prior banking relationship, or by auditing Bidder 1. The degree to which banks are successfully reducing the information asymmetry is an empirical issue. The very existence of bank-bidder financing may simply reflect a competitive banking market with no overbidding. However, it is also consistent with our model framework, where information asymmetries do not prohibit coalition formation. The key empirical

[20]The derivatives of the participation constraints of the bidder and of the bank when binding are, respectively,

$$\frac{\partial \bar{T}(v_1)}{\partial v_1} = \begin{cases} (p_c(v_1) - v_1)g(p_c)\frac{\partial p_c(v_1)}{\partial v_1} - (G(p_c) - G(v_1)) \\ (1 - G(p_c))\frac{\partial p_c(v_1)}{\partial v_1} - (1 - G(v_1)), \end{cases}$$

which, given the monotonicity condition $\partial h^{-1}(v)/\partial v \geq 0$, are less than or equal to zero.

issue below is whether actual auction premiums reflect overbidding incentives of the type implied by our symmetric information framework.

4 Bid frequencies and average auction premiums

Several commentators, e.g., Aghion, Hart, and Moore (1992), Strömberg (2000), and Hotchkiss and Mooradian (2003), warn that the type of auctions studied here may lack competition. The theoretical analysis above presumes the existence of (at least) two bidders. Thus, we start the empirical analysis examining the degree of auction competition and the magnitude of average auction premiums across bid outcomes. The auction premium data is explored in greater detail in Section 5 where we present our cross-sectional tests of Proposition 2.

4.1 Auction data

We study the sample of Swedish bankruptcies in Strömberg and Thorburn (1996), expanded to include firm- and auction characteristics required to test our bidding hypotheses. First, the additional information includes bidder interest, actual bids, and liquidation-value estimates, obtained in direct communication with auction trustees. Second, we incorporate information on bank financing from the national register of corporate floating charge claims ("Inskrivningsmyndigheten för företagsinteckning"), supplemented by the trustees. This information identifies cases where the old bank finances the winning bidder in the auction. Third, we create a quarterly business cycle index using information from Statistics Sweden (SCB). Fourth, we incorporate the information on industry distress and profit margins compiled by Thorburn (2000) for this sample.

The sample contains 263 bankruptcies from 01/88–12/91, selected from a population of 1,159 bankrupt firms having at least 20 employees.[21] The sample firms are small, privately held companies with concentrated ownership. On average, book value of assets is $2.5 million, and the CEO owns 59% of the equity. As shown in the last row of Table 2, of the total sample of 263 bankrupt firms, 53 (20%) filed a prepackaged bankruptcy (auction prepack), while the remaining 80% (207 cases) petitioned for bankruptcy without a prepack arrangement. Of these 207 filings, 60 (29%)

[21] Over the sample period, 6% of all (approximately 16,000) Swedish corporations had 20 employees or more. 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. See Thorburn (2000) for a detailed description of the sampling procedure.

are liquidated piecemeal (piecemeal liquidations) and 147 (71%) are sold as a going concern (going-concern auctions), while we lack information to classify three cases. About sixty percent of all going concern sales (auction prepacks and going-concern auctions combined) are sales back to the old owner/manager (salebacks).

Table 2 also shows the distribution of the bankruptcy filings across eight industry groups. The largest industry is Manufacturing with 29% of the sample (76 cases), followed by Wholesale/Retail and Construction with 17% and 13%, respectively. A further 29 cases (11%) are in Transportation and 26 cases (10%) are in Hotels and Restaurants. The distribution of auction outcomes is quite similar across industry groups, with the greatest relative frequency of piecemeal liquidations occurring in Transportation (14 of 29 cases, or 48%). The industry with the highest proportion salebacks is Construction (20 of 26 cases, or 77%). As it turns out, controlling for industry fixed effects does not materially change our conclusions, and we do not report industry-specific results in the analysis below.

4.2 Bid frequencies and bank financing

The auctioneer records potential bidders that request information about the firm's assets and existing bids, and who express an interest in participating in the auction. Some of the interested bidders proceed with a formal offer, while others are deterred by competition. The existence of a pool of interested bidders is evidence of potential competition in the auction. These potential entrants may drive competitive bidding even with a single actual bidder, as a low offer may induce entry. In the empirical analysis below, we condition premium regressions on both the level of actual and potential competition in the auction.

Figure 3 provides a frequency distribution for the number of potential buyers expressing an interest in bidding ($Interest$), and the number of submitted bids ($Bids$). The variable $Interest$ includes those who subsequently submit actual bids. The number of interested bidders ranges from one to forty in the sample of 102 going-concern auctions with bid information. Moreover, 75% of the auctions attract multiple bidder interest. The number of actual bids ranges from 1 to 22, with multiple bids in 63% of the going-concern auctions.

Table 3 shows bid frequencies, the number of cases where the old bank finances the winning bid, auction premiums, and debt recovery rates. The table splits the total sample in going-concern sales, auction prepacks and piecemeal liquidations. In Panel A, the average number of interested bidders equals 5.5 with a median of 3.0 for the total sample. This expression of interest translates into multiple bids in a majority of the auctions. The average number of submitted bids is 3.6 with a median of 2.0. In the sample of auction prepacks, the number of interested bidders and actual bids average 1.2, ranging from 1 to 2.[22] In piecemeal liquidations, where bids are for individual assets, expression of bidder interest and actual bids are 11.4 and 9.8 (median values of 5), respectively.

Table 3 shows that the auctions are often active also for the subsample of salebacks. In salebacks resulting from going-concern auctions, the average number of interested bidders and actual bidders are 5.3 and 3.0, respectively. Using the median values, the typical saleback attracts two competing bidders and interest from a third, potential bidder. There is no significant difference in the average level of either actual or interested bidders across salebacks and sales to new owners (the p-value for this difference is greater than 0.3). This evidence contradicts the conjecture by Strömberg (2000) that salebacks lack competition. With incomplete bid information, Strömberg (2000) estimates that competing bids occur in only one-quarter of the auctions. Updating his cases with our bid data reveals that the correct estimate is two-thirds, and three-quarters when adding expressed bidder interest (Figure 3). Expressed bidder interest on average raises the pool of potential bidders to 2.5 even in the subsample where there is only a single actual bid in the auction.

Figure 3 shows a total of 25 auctions (25% of the sample going-concern sales with bid data) with only a single expression of bidder interest—and therefore only a single bidder. Of these 25 cases, 21 are salebacks (40% of the salebacks with bid data). Recall that the rules explicitly requires the trustee to actively seek out competing bids before approving a saleback. Moreover, both the bank and the government supervisory authority require this rule to be followed. Also, we find that the average recovery rate in this subsample is indistinguishable from the sample averages reported below. Nevertheless, there may be concern with lack of competition in this subsample of 21 cases. In the following regression analysis, we account for the effect on auction premiums of different levels of competition by including controls for the number of actual and potential bids in the auction.

A decision by the filing firm's bank to finance a bidder adds liquidity to the auction. In Panel B of Table 3, we present information on the bank financing of the winning bidder for a total of 132

[22]In a prepack filing, the trustee typically approves the petitioner's purchase agreement without recording potential competition. Thus, the data on bidders in prepacks is incomplete.

going concern sales (going-concern auctions and prepacks). When the old bank does not finance the winning bidder, it either finances a losing bid or none of the bids. There are no public records of the bank's actions when it does not finance the winner. The bank finances the winning bidder in approximately half (48%) of the cases, distributed as 44 of 95 going-concern auctions and 20 of 35 auction prepacks. Focusing on salebacks, the winner is financed by the bank in 49% of salebacks following a going-concern auction, and in 62% of saleback-prepacks. Overall, we conclude that the bank adds substantial liquidity across auctions, with no particular tendency to finance salebacks.

4.3 Average premiums and recovery rates

Competition affects average auction premiums as well as total debt recovery rates. We focus here on two predictions. First, competition to run the firm as a going concern is expected to produce substantially greater premiums in going-concern sales than in piecemeal liquidations. Second, if salebacks are in fact as competitive as non-salebacks, they should produce similar (unconditional) average premiums.

Panel C of Table 3 lists the average and standard error of the auction premium and the debt recovery rate. The percent auction premium is computed as $P/V_L^a - 1$, where P is the price paid by the winning bidder and V_L^a is the trustee's liquidation value estimate for the assets sold in return for P. Non-core assets such as real estate holdings, accounts receivables, securities, cash holdings, etc., are often sold and collected separately even when the firm's core operations are auctioned as a going concern, thus $V_L^a < V_L$. We use the bankruptcy file to infer the asset exclusion. This opens for a measurement error in V_L^a (but not in V_L) if the file omits information on some of the assets sold.

Judging from Table 3, the error in V_L^a does not bias the premium estimate: The average percentage premium is only 8% for piecemeal liquidations, with a dollar value of \$0.005 mill. The standard error of this premium estimate is also 8%. Thus, using a standard t-test, we cannot reject the hypothesis that the average premium in piecemeal liquidations is zero. In contrast, the premium in going-concern auctions averages 125% with a standard error of 24%. The p-value for the difference in average premiums across going-concern sales and piecemeal liquidations is 0.00. This is consistent with our maintained hypothesis that competition produces greater auction premiums when the going-concern value is positive. Also, in Table 3, the average premium is 131%

for salebacks (standard error of 30%), and 120% for non-saleback going-concern auctions (standard error of 44%). We cannot reject the hypothesis of equal average premiums in salebacks and sales to company outsiders.

Turning to recovery rates, the average total debt recovery in Panel C is 26% for piecemeal liquidations and 39% for going-concern auctions, with the difference being significant at the one percent level. In going-concern auctions, debt recovery averages 38% for salebacks versus 41% in non-salebacks. In prepackaged auctions, the average recovery is 32%, and there is again no significant difference between salebacks and non-salebacks.

Finally, Panel C lists the bank's liquidation recovery rate R_L. As noted in Section 2, debt claims senior to the bank averages only 1% of total debt. When computing R_L, we reduce V_L with any such senior debt. The trustee's estimate of V_L is typically not available for auction prepacks and R_L is therefore not shown for this category. The frequency distribution of R_L is plotted in Figure 4 for both going-concern auctions and piecemeal liquidations. The bank receives full recovery at the trustee's 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_L from 0 to 99%. In Table 3, the average value of R_L is 45% in piecemeal liquidations and 66% in going-concern auctions. This difference is statistically significant at the one percent level, indicating that firms liquidated piecemeal tend to have more impaired bank debt. Again, there is no discernable difference between salebacks and non-saleback transactions.[23]

5 Auction premiums and the overbidding hypothesis

5.1 Going-concern sales versus piecemeal liquidations

Hypothesis 1 (H1) summarizes the empirical implications of the overbidding theory:

> **Hypothesis 1 (Overbidding):** *For a bank with a senior debt claim B on the bankrupt firm, coalition overbidding predicts the following empirical relationship between the premium paid in the auction, $ln(P/V_L^a)$, and the bank's liquidation recovery rate, $R_L \equiv V_L/(B-S)$:*

[23] While Table 3 indicates that saleback bidders do not pay lower premiums, they may capture greater rents, e.g. from private benefits of control not competed away by outside bidders.

(i) If $R_L < 1$, the coalition overbids, resulting in

$$\frac{\partial ln(\frac{P}{V_L^a})}{\partial R_L} < 0.$$

(ii) If $R_L = 1$, the bank's debt is not impaired and there is no overbidding.

(iii) If the going-concern premium is close to zero, there is no coalition formation or overbidding, and the auction results in piecemeal liquidation.

(iv) Ex post, when the coalition loses the auction, the premium paid by the winner directly reflects overbidding. When the coalition wins, the premium it pays reflects overbidding only indirectly (through the price offered by bidder 2), and the premium is less sensitive to R_L:

$$\frac{\partial ln(\frac{P|p_c<p_2}{V_L^a})}{\partial R_L} < \frac{\partial ln(\frac{P|p_c\geq p_2}{V_L^a})}{\partial R_L} < 0.$$

We use a cross-sectional regression framework where the auction premium $ln(P/V_L^a)$ is regressed on the bank's liquidation recovery rate R_L, and a vector X of control variables. Structurally, the direction of causality in these cross-sectional regression runs from R_L (observed at the beginning of the auction) to the auction premium through the hypothesized incentive to overbid. Notice also that, in our institutional setting, it is safe to assume that R_L is exogenous to the bank. For the bank to increase R_L it would need to reduce B prior to bankruptcy filing. However, the Swedish secondary market for private bank debt was illiquid during our sample period, and particularly so for distressed debt.

We test implications (i)-(iii) in H1 using the combined sample of going-concern sales (indicated by the binary variable *Concern*) and piecemeal liquidations (with *Piecemeal* as indicator variable) and the following three linear regressions:

$$ln(\frac{P}{V_L^a}) = \begin{cases} \alpha_1 + \beta_1 Piecemeal + \beta_2 R_L + \gamma_1 X + \epsilon_1 \\ \alpha_2 + \beta_1 Piecemeal + \beta_3 R_L * Piecemeal + \beta_4 R_L * Concern + \gamma_2 X + \epsilon_2 \\ \alpha_3 + \beta_1 Piecemeal + \beta_2' R_L + \beta_3' R_L * Piecemeal + \gamma_3 X + \epsilon_3 \end{cases} \quad (5)$$

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. The different indicator- and interaction variables in the three regression offer different ways to check for overbidding effects. In the first regression, $\beta_1 < 0$ reflects the absence of going-concern premiums in piecemeal liquidations, while $\beta_2 < 0$ captures the effect of overbidding in going-concern auctions. In the second regression, $\beta_3 = 0$ indicates absence of overbidding for piecemeal liquidations, while $\beta_4 < 0$ indicates overbidding in the sample of going-concern auctions. In the third regression, $\beta_2' \equiv \beta_4 < 0$ again captures the presence of overbidding for going-concern auctions, while for piecemeal liquidations $\beta_3' \equiv \beta_3 - \beta_4 > 0$ is required to undo the effect of overbidding captured by β_2'. In sum, H1 implies the following:

$$\mathbf{H1(i)} - \mathbf{H1(iii)}: \;\; \beta_1 < 0 \;\text{ and }\; \beta_2 < 0; \; \beta_3 = 0 \;\text{ and }\; \beta_4 < 0; \;\; \beta_2' < 0 \;\text{ and }\; \beta_3' > 0.$$

Variable definitions, including the control variables in X, are listed in Table 4, with the pairwise correlations shown in Table 5. The control variables include $Size$ (natural logarithm of book value of total assets), $Profmarg$ (pre-filing, industry-adjusted operating profitability), and $Secured$ (the fraction of secured debt in the capital structure). We use $Secured$ as a proxy for the proportion tangible assets.[24] From the pairwise correlations in Table 5, R_L is significantly negatively correlated with the piecemeal liquidation dummy (confirming Figure 4 and Table 3) and with $Secured$. The negative correlation between R_L and $Secured$ is -0.35 and is in part driven by the high correlation between $Secured$ and the fraction bank debt B of total debt (R_L is decreasing in B). $Secured$ is also significantly and positively correlated with $Size$.

Table 6 shows the estimated regression coefficients for the system of equations in (5). Panel A uses the total sample of 173 going-concern sales and piecemeal liquidations with available data.[25] Panel B restricts the sample to the 118 cases with $R_L < 1$, while Panel C allows $R_L = 1$ but eliminates all piecemeal liquidations. The regressions produce adjusted R^2 ranging from 0.14 to 0.20. Of the three miscellaneous control variables, only $Secured$ is statistically significant. As expected, the indicator $Piecemeal$ is always negative and significant (confirming the finding of

[24] Absent data on the market value of equity for the (private) firms in our sample, *Secured* is a useful proxy for this proportion as long as firms lever up their tangible assets and the cross-sectional variation in the total debt ratio is small.

[25] The data reduction from 263 reflects missing information on V_L. Recall that, by definition, there is no data on V_L in the 50 auction prepacks.

Table 3 of lower auction premiums in piecemeal liquidations). Presumably, a piecemeal liquidation occurs because no bidder has a sufficiently large going-concern valuation of the bankrupt firm. In our data, piecemeal liquidations occur only in the absence of a going-concern bid.

In panel A, the coefficients on R_L, $\beta_2 = -0.881$ and $\beta_2' = -1.134$, are of the right sign and highly significant (p-values of 0.00). In the second regression, β_3 is indistinguishable from zero as predicted (p-value 0.70). Moreover, $\beta_4 = -1.133$ and significant. In the third regression, $\beta_3' > 0$ as predicted (p-value of 0.013). These results essentially repeat in Panel B, where the sample is restricted to cases with impaired bank debt ($R_L < 1$). Reducing the sample from 173 to 118 appears to reduce power, however. The coefficient estimate for β_3' in Panel B is of similar magnitude as in Panel A but is now insignificant (p-value of 0.12). That is, we can no longer reject the hypothesis that $\beta_3 = \beta_4$, i.e. that the degree of overbidding differs across the two subsamples.

In Panel C, we control for the level of competition in the auction using $Bids$, $Interest$, as well as an indicator variable labelled $> 2Bids$ for the presence of more than two actual bids in the auction. Inclusion of these variables does not change the impact of R_L on the auction premium. Neither $Bids$ nor $> 2Bids$ receive significant coefficients. The variable $Interest$ is significant at the 3% level with a negative sign. While our theory does not deliver predictions for $Interest$, one interpretation of the negative sign is that auctions with relatively low going-concern valuations tend to attract a somewhat greater pool of interested bidders (while the number of actual bids remain the same). Another interpretation is that smaller pools of bidder interest does not adversely effect winning auction premiums. The key conclusion emerging from Table 6 is that lower values of R_L lead to higher values of the premium paid in the auction, as predicted by H1(i)-H1(iii).

The implication of H1(iv) is that the auction premium paid by the winner should be more sensitive to R_L—and greater—when the coalition overbids and loses than when it overbids and wins. When the coalition loses, the winner pays $p_c(v_1)$ and the dependent variable in our cross-sectional regression directly and fully reflects the overbidding. When the coalition wins, it pays $p_2 < p_c(v_1)$. As shown in Section 3 above, overbidding increases the range of bids by Bidder 2 against which the coalition will win. Thus, when the coalition wins, the dependent variable in our cross-sectional regression reflects overbidding only indirectly. The sensitivity of the observed premium to R_L in the subsample of auctions where the coalition wins is therefore negative but smaller than when the coalition loses.

We test this implication using our binary variable $Bankfin$, which takes on a value of 1 if the old bank finances the winning bidder and 0 if it does not, and its complement $NoBankfin$. The regression specifications is as follows:

$$ln(\frac{P}{V_L^a}) = a + b_1 R_L * Bankfin + b_2 R_L * NoBankfin + cX + u \tag{6}$$

$$\mathbf{H1(iv)}: \ b_2 < b_1 < 0.$$

The results of this estimation are reported in Table 7 for the sample of 84 going-concern auctions. We exclude piecemeal liquidations since no single bidder wins the auction (there is a winner for each separate asset sold). The table shows the impact of including controls for $Bids$ and $Interest$. However, neither of these two variables receive significant coefficients.

Hypothesis H1(iv) receives mixed support. Since there should be overbidding regardless of the ex post outcome, H1(iv) predicts that the coefficients b_1 and b_2 should both be negative. Focusing on the first three regression specifications of Table 7, this prediction is supported at the 1% level of significance, with coefficient estimates ranging from -1.2 to -1.5 for b_1 and -1.4 to -1.7 for b_2. However, while the estimated coefficients of b_2 always exceed the corresponding estimates of b_3, they are not statistically different at the 10% level of significance. Thus, we cannot conclude that the sensitivity of the observed auction premium to R_L is smaller in the subsample where the coalition wins.

Recall that $NoBankfin$ represents cases where the old bank either finances a losing bid or none of the bids. Our theory predicts the greatest amount of overbidding in the bid-and-lose sample, and no overbidding in the sample with no bank financing. Therefore, pooling the two outcomes (bid-and-lose and no-financing) dilutes the overbidding effect of the cases under $NoBankfin$. From Proposition 3.3, however, we know that this dilution effect is smaller when the bidder has issued a personal loan guarantee to the bank. In this case, the bidder has a private incentive to overbid even in the absence of a coalition formation. As data on loan guarantees is not publicly available, we are unable to quantify the actual dilution effect when $NoBankfin$ equals 1. This may explain why we cannot reject that $b_1 = b_2$. However, since b_2 is negative and significant, there is evidence of overbidding also when $NoBankfin$ equals 1.[26] Our conjecture is that the source of this overbidding is bank-financing of losing bidders and/or bidders with personal loan guarantees.

It is also interesting to compare average auction premiums across the subsamples with and without ban-financing of the winning bidder. If the bank is uninformed, it selects the coalition partner (Bidder 1) randomly. In this case, the theory implies that the premium paid is on average lower when the coalition wins than when it loses (recall that $E(p_2) < E(p_c(v_1))$). This argument implies that the binary variable $Bankfin$ should receive a negative coefficient when added to regression equation (6). On the other hand, the bank may have private information about the valuation of one or more potential bidders in the auction. If the entry of these bidders are exogenous to the bank, the above prediction holds a fortiori. However, as discussed in the section below on fire-sales, liquidity constrained industry insiders may be prevented from entering the auction. In this case, the bank may want to relax the liquidity constraint by offering bid financing. Inducing a high-valuation bidder to enter may be more valuable to the bank than financing a low-valuation bidder and overbid. This scenario implies a positive coefficient on $Bankfin$.

Regressions 4 - 9 in Table 7 include $Bankfin$ as a free-standing binary variable. In all these regressions, the coefficient for $Bankfin$ is positive and significant, indicating that the bank on average finances bidders with greater going-concern valuations. Inclusion of $Bankfin$ does not alter our inferences regarding R_L (which remains negative and highly significant). Moreover, as shown in the last three regressions, b_1 and b_2 remain negative and significant. However, inclusion of $Bankfin$ now reverses the relative magnitude of b_1 and b_2, so that $b_1 < b_2$, which contradicts $H1(iv)$. The source of this impact of $Bankfin$ remains unresolved. We are unable to determine any significant instrument for the bank's selection, other than our observation that the bank tends to finance bidders with relatively high average final auction premiums. We return to this issue in Section 6.4 below, where we report the results of a multinomial logit model for the bank's financing decision.

[26]Given the significance of b_2, our tests with $NoBankfin$ appears to have power. We are unaware of any other theory that predicts negative values for b_1 and b_2.

5.2 Robustness issues

5.2.1 Allowing for nonlinear impact of R_L

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 $p_c(v) < B$ (and therefore for $R_L < 1$). 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 the Box-Cox transformation to R_L. A Box-Cox transformation of a variable x, denoted $x^{(\lambda)}$, is defined as[27]

$$x^{(\lambda)} = \begin{cases} (x^\lambda - 1)/\lambda & \lambda \neq 0 \\ \ln x & \lambda = 0. \end{cases} \tag{7}$$

When applied to R_L, the resulting maximum likelihood estimate of λ determines the functional form of the relationship with auction premiums, where $\lambda = 1$ implies linearity.

The results of the Box-Cox estimation is shown in Panel A of Table 8 for the sample of going-concern sales where $R_L < 1$. The estimated value of λ is 1.53 with a p=value of 0.69. We cannot reject the hypothesis that λ is zero (in which case the transformation is $ln(R_L)$) or one (linearity). When running the regression with $\lambda = 1.53$, the coefficient on R_L is again negative and significant, with a value of -1.48 (p-value of 0.00). When using $\lambda = 0$, the coefficient on $ln(R_L)$ is -0.35, also highly significant.[28] In either case, the results are consistent with the overbidding theory.

5.2.2 Impact of the sample correlation between V_L and V_L^a

The coefficient estimates β_2 and β_2' for R_L reported in Table 6 do not separate the effects of overbidding from the effect of the sample correlation between V_L^a (the denominator of the dependent variable) and V_L (the numerator of R_L). The simple correlation is 0.44 in the sample of 173 going-concern sales and piecemeal liquidations used in Panel A of Table 6. To examine whether this sample correlation alone may drive the significance of the overbidding variable, we perform two separate checks. In the first, we reduce the two coefficient estimates of -0.881 and -1.134 by 44

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

[28] With $\lambda = 0$, the Box-Cox transformation is $ln(R_L)$, which requires the elimination of four observations with $R_L = 0$ from the regression.

percent. Leaving the standard error unchanged, the null hypothesis that the reduced coefficients are equal to zero is rejected on a 1% level with t-values of -2.63 and -3.02, respectively. Thus, the overbidding variable R_L has a significant impact on auction premiums after netting out the simple correlation between V_L^a and V_L.[29]

Second, in auctions where the going-concern value is close to zero, the theory predicts that the auction will result in piecemeal liquidation with zero overbidding (H1(iii)). In Panel B of Table 8, we estimate the coefficient β_2 on R_L for the sample of piecemeal liquidations. With a standard deviation of 56%, there is substantial cross-sectional variation in the final auction premium in the sample of piecemeal liquidations. Nevertheless, the estimated coefficient of β_2 is a statistically insignificant 0.124 (p-value 0.741). Thus, this regression rejects the proposition that the overbidding variable R_L (or the control variables) helps explain the cross-sectional variation in the piecemeal-liquidation premium. Importantly, the insignificance of β_2 emerges despite the fact that the sample correlation between V_L^a and V_L is at work in this regression as well. We conclude that our overall statistical inference regarding the impact of overbidding on auction premiums is not seriously confounded by the sample correlation between V_L^a and V_L.

6 Auction premiums and fire-sale conditions

In the overbidding theory, the focus is on the incentive of the bankrupt firm's major creditor to supply liquidity and produce greater bid prices in the auction. In contrast, Shleifer and Vishny (1992) and others conjecture that bankruptcy auctions may suffer from illiquidity and lack of competition due to fire-sale conditions. Fire-sale conditions occur when bankruptcy filings are correlated with conditions of low auction demand, e.g. due to industry-wide financial distress. We examine this hypothesis next.

6.1 Nesting the fire-sale and overbidding hypotheses

Hypothesis 2 (Fire-sales): *Auction premiums tend to be lower for bankruptcies that occur when markets are relatively illiquid and outside demand for the firm's assets is*

[29] Note that the simple correlation of 0.44 overstates the actual correlation in the regression because we subtract debt senior to the bank when constructing R_L.

low, as indicated by conditions of severe industry-wide financial distress and a business cycle downturn.

Table 9 shows the effect on the auction-premium regressions in Table 6 of adding the two key variables capturing fire-sale conditions. The first variable is the degree of industry distress ($Distress$). It is measured as in Thorburn (2000) and represents the fraction of all firms in the industry of the bankrupt firm that is financially distressed in the year of the bankruptcy filing. Financial distress is defined as either having an interest coverage ratio (EBITDA plus interest income divided by interest expense) of less than one or filing for bankruptcy in the same calendar year. The source of this information is financial statements from UC for the entire population of more than 15,000 Swedish firms with at least 20 employees. The industry is defined on a 4-digit level. $Distress$ equal-weighs the firms in the same industry. We also computed $Distress$ as the fraction of the assets in a given industry that is distressed. Results when using the asset-weighted distress indicator are indistinguishable from the results reported in Table 9.

The second fire-sale variable is the business cycle index change $\Delta Cycle$, measured as the change in a quarterly index $Cycle$. This index is an equal-weighted sum of the producer price index, the gross national product, aggregate consumption, rate of unemployment, and total number of bankruptcy filings. All index components are normalized with their mean and standard deviation. The first three components enter the index with a positive sign, and the remaining two with a negative sign. $\Delta Cycle \equiv (Cycle_0 - Cycle_{-1})/Cycle_{-1}$, where 0 is the quarter ending with the month of the bankruptcy filing. Information on the components used to construct $Cycle$ is collected from Statistics Sweden. Over the sample period, Sweden went through a general business upturn (1988-1990) followed by a deep recession in 1991. Thus, the variable $\Delta Cycle$ has substantial variation across the sample.

The pairwise Pearson correlation coefficients between the two fire-sale variables and either the overbidding variable R_L or the firm-specific control variables is insignificant (Table 5). The parameter estimates in Table 9 also show that inclusion of fire-sale variables in the premium regressions does not add explanatory power. Specifically, we cannot reject the hypothesis of zero coefficients for $Distress$ and $\Delta Cycle$ in any of the nine regression specifications. This conclusion holds also when we exclude the overbidding variable R_L from the regression (which results in a significant decline in the regression R^2). When included, the sign and significance of the overbidding variable R_L is virtually unchanged from Table 6. A similar conclusion holds for the miscellaneous control variables in the regression.

Panel B of Table 9 excludes piecemeal liquidations. This allows us to focus on bank financing ($Bankfin$), salebacks (*Saleback*), and the number of bids (*Bids*) in the sample of going-concern auctions. The pairwise correlations between these variables and the fire-sale variables *Distress* and *Cycle* are all small and insignificantly different from zero (Table 5). As in Table 7, $Bankfin$ receives a significantly positive coefficient when R_L is included.[30] *Saleback* receives an insignificant coefficient in all specifications, indicating that premiums in salebacks do not differ systematically from premiums paid in sales to outside investors. Finally, we include the variable *Bids* as an instrument for the degree of competition in the auction. Competition among bidders presumably counteracts fire-sale tendencies.[31] *Bids* receives an insignificant coefficient. One consistent explanation is that the typical auction is competitive (reflected in premiums) and does not depend on the cross-sectional variation in the number of bidders nor on fire-sale conditions.[32]

The regression results in Table 9 fail to support the fire-sale argument. We address two main robustness issues concerning this finding. The first is the potential for fire-sale conditions to directly impact the piecemeal liquidation value estimate V_L. The second concerns the potential for a bias in the coefficient estimates due to the exclusion of auction prepacks (where premium information is unavailable). Finally, we provide evidence on the determinants of the various auction outcome probabilities more generally.

6.2 Does V_L vary with fire-sale conditions?

The dependent variable in Table 9 is the final auction price scaled with the trustee's piecemeal liquidation value estimate V_L. If this estimate varies with fire-sale conditions in the same way as the auction price itself, the regression will not reveal a premium impact of the fire-sales variables.

[30]The Pearson correlation coefficient between $Bankfin$ and R_L in Table 5 is an insignificant 0.07.

[31]In the model of Section 3, it is optimal to bid the full private value regardless of the number of rival bidders. Increasing the number of bidders raises the probability that one of the bidders has a high valuation and thus may increase the premium.

[32]Replacing *Bids* with the number of interested bidders (*Interest*), or a dummy indicating multiple bids, does not alter the conclusions. Furthermore, as Strömberg (2000), we also included a binary variable indicating that the buyer is neither a direct (3-digit SIC) competitor nor an owner of the auctioned firm. This variable is highly correlated with both *Saleback* and $Bankfin$, but its inclusion does not alter the empirical results of Table 9.

To examine this possibility, we present in Table 10 the same basic regressions as in Table 9. In panels A and B, the dependent variable is $ln(V_L)$, while in panels C and D it is V_L/A, where A is the prefiling book value of total assets used earlier to define $Size = ln(A)$. Scaling with book assets has the advantage of controlling for firm size using a measure that itself is not affected by fire-sale conditions during the auction. The regressions exclude the overbidding variable $R_L = V_L/B$.

The main conclusion from Table 10 is that neither $Distress$ nor $\Delta Cycle$ receive statistically significant coefficient estimates. That is, V_L does not vary systematically with changes in fire-sale conditions. Our rejection of the fire-sale hypothesis using the premium regressions in Table 9 is evidently not driven by an offsetting cross-sectional variation in the piecemeal liquidation value estimate itself.

Not surprisingly, Table 10 also shows that V_L is significantly lower for piecemeal liquidations ($Piecemeal$) and for firms with low prefiling industry-adjusted profitability ($Profmarg$). In panels A and B, V_L is positively related to $Size$, also as expected. There is some evidence that when the bank finances the winner in the auction ($Bankfin$), V_L tends to be greater (provided the regression also includes the number of bids $Bids$). Finally, there is no systematic impact of either $Saleback$ or $Bids$ on V_L in going-concern auctions.

6.3 Selection bias from the prepack decision?

Our regressions with the going-concern premium as dependent variable necessarily exclude auction prepacks since V_L^a is unavailable for this filing category. A firm approaching bankruptcy must decide whether or not to work out a prepackaged sale. This decision is possibly driven by the firm's view of current fire-sale conditions. The negotiated auction prepack effectively sets a minimum selling price, subject only to a fairness test by the bankruptcy trustee. Thus, creditors and owner/managers may prefer a negotiated prepackaged bankruptcy filing if they view market conditions as likely to produce low auction prices.

Let the prepack decision for company i be a function of $\gamma' Z_i$, where Z_i is a vector of firm- and market characteristics and γ' is the corresponding vector of coefficients. Moreover, let β denote the parameter vector in the auction premium model estimated above (tables 6 and 8). We earlier estimated

$$ln(\frac{P}{V_L^a}) = \beta' X_i + u_i \tag{8}$$

although the data are generated by

$$ln(\frac{P}{V_L^a}) = \beta' X_i + u_i \quad \text{if} \quad \gamma' Z_i \geq u_{zi} \quad (\text{non}-\text{prepack filing}). \tag{9}$$

Here, u_{zi} is the residual in a probit regression of the prepack decision with explanatory variables Z_i, where the firm selects a prepack filing if $\gamma' Z_i < u_{zi}$. If the regression error term u_i is correlated with u_{zi}, Eq. (7) is misspecified and produces biased estimates of β_1. The standard correction for this selection bias involves a two-step procedure.[33] The choice model $\gamma' Z$ is estimated in the first step, while in the second step β is estimated as

$$ln(\frac{P}{V_L^a}) = \beta' X_i + \eta \frac{\phi(\gamma' Z_i)}{\Phi(\gamma' Z_i)} + u_i, \tag{10}$$

where ϕ_i and Φ in the selectivity correction term (inverse Mill's ratio) are the values of the standard normal density and the cumulative normal distributions, respectively, evaluated at $\gamma' Z_i$.

Since we are interested in whether prepacks are selected to avoid expected costs of fire-sale conditions, the selection model includes the variables $Distress$ and $\Delta Cycle$ as well as our three control variables:

$$\gamma' Z_i = \gamma_0 + \gamma_1 Distress_i + \gamma_2 \Delta Cycle_i + \gamma_3 Size_i + \gamma_4 Profmarg_i + \gamma_5 Secured_i \tag{11}$$

In the probit regression, the dependent variable takes the value 0 if firm i selects a prepack filing (53 cases) and 1 if it selects a regular filing (207 cases). Importantly, the estimation does not produce a statistically significant coefficient for either of the two fire-sale variables. Of the control variables, $Secured$ and $Size$ receive statistically significant coefficients. The greater the proportion secured debt (tangible assets) and the smaller the firm, the lower the probability of a prepack choice. The probit regression as a whole is statistically significant only at the 16% level (using a standard χ^2 test).

[33] See, e.g., Heckman (1979), Maddala (1983), and Eckbo, Maksimovic, and Williams (1990).

In the second step, we form the inverse Mill's ratio and include this in the regressions of Table 9. The results are reported in Table 11. The coefficient estimates of the Mill's ratio are statistically insignificant in all but the first regression of Panel B (where the sample includes going-concern auctions only). Whenever the Mill's ratio receives an insignificant coefficient, there is no change in the key statistical inferences from Table 9.[34] Comparing the first regression of Panel B across Table 9 and Table 11, the Mill's ratio receives a coefficient of -11.1 (p-value of 0.09) and it produces a marginally significant coefficient for $Distress$, $Size$ and $Profmarg$. The coefficient for $Distress$ changes from 0.2 (p-value of 0.66) in Table 9 to 2.0 (p-value 0.07) in Table 11. The positive premium effect of $Distress$ is puzzling and cannot be explained by fire-sale arguments. Moreover, inclusion of the Mill's ratio does not alter the sign, magnitude or statistical significance of the overbidding variable R_L. Overall, there is no evidence that the estimates of Table 9 reflect a selection bias from the prepack choice.

6.4 Do fire-sale conditions drive salebacks and bank financing?

In the previous section, we performed a Heckman correction for prepacks because premium data is unavailable for these outcomes. Saleback and bank-financing of the winning bidder are also interesting choice variables. Since these subsamples are already represented in the premium regressions above, they do not give rise to selection bias issues. However, the determinants of the probabilities of these auction outcomes are interesting in their own right. To identify potential effects of fire-sale conditions, we separate out piecemeal liquidation outcomes using a multinomial logit technique.

Let $\pi_n(Z_i)$ denote the probability of auction outcome $n = 1, 2, 3$ conditional on the model $\gamma' Z$ given by Eq. (10). We estimate $\pi_n(Z_i)$ using multinomial logit:

$$\pi_n(Z_i) = \exp(\gamma_n' Z_i) / \sum_{n=1}^{3} \exp(\gamma_n' Z_i). \tag{12}$$

A change in the value of the single characteristic z_k in Z changes all probabilities simultaneously.

[34]In these regressions, the only change from including the inverse Mill's ratio is to make the variable $Bids$ and $Secured$ consistently insignificant.

For each outcome probability, we compute the partial derivative as

$$\partial\pi_n/\partial z_k = \pi_n(\gamma_{kn} - \sum_{e=1}^{3} \gamma_{ek}\pi_e). \tag{13}$$

The partial derivatives and the corresponding asymptotic p-values are listed in Table 12 for three sets of three auction outcomes. The three outcomes always include piecemeal liquidation. In Panel A, the two remaining outcomes are auction prepack and going-concern auction. Panel B focuses on saleback versus non-saleback, and Panel C on whether the old bank versus a new bank finances the winning bidder.

Panel A reveals that the probability of a going concern auction increases with $\Delta Cycle$, i.e., is higher following a business cycle upturn (p-value of 0.06). The coefficient estimate for $\Delta Cycle$ is greater for going-concern auctions than for either prepacks and piecemeal liquidations. Thus, prepacks are somewhat similar to piecemeal liquidations in terms of the impact of business cycle conditions, possibly reflecting the use of prepacks to reduce the risk of fire-sale. As before, prepacks are more likely the lower the fraction secured debt.[35]

Panel B of Table 12 focuses on the saleback decision. Interestingly, salebacks are more likely following a business cycle upturn. There is no significant impact of $Distress$. Thus, there is no evidence that salebacks represent an endogenous response to the risk of fire-sale. A similar conclusion follows for the bank-financing decision in Panel C, where both fire-sale variables receive statistically insignificant coefficient estimates. In sum, while there is some evidence that prepacks emerge in response to low market conditions (as measured by $\Delta Cycle$), neither the saleback decision nor the bank financing decision appear to be driven by concerns with fire-sales.

7 Auctions and efficiency

Our empirical analysis indicates that auction premiums behave as if overbidding-incentives are played out while, at the same time, final premiums are independent of fire-sale conditions. By offering bid financing, the old bank relaxes potential liquidity constraints on the demand side of the auctions. This in turn lowers the probability that the bankrupt firm is purchased by relatively inefficient buyers (e.g., an industry outsider as in Shleifer and Vishny (1992)). Thus, the overbidding

[35] Recall that the Heckman procedure of the previous section failed to identify a premium effect of this selection.

incentives modelled here counters inefficiencies resulting from illiquidity and fire-sale conditions, which is consistent with our empirical results.

However, while the auction allocates the bankrupt firm to the highest bidder, this bidder need not be the one with the highest valuation. In Section 3, this possibility gave rise to the requisite transfer $T(v_1)$ from the bank to induce participation by Bidder 1 in the coalition. Figure 5 illustrates the potential for inefficient auction outcome with coalition overbidding. If the coalition overbids and lose, bidder 2 has the highest private valuation, and the outcome is efficient. If the coalition overbids and wins, there are two possibilities. In the first, $v_1 > v_2$ and the outcome is efficient. In the second, $v_1 < v_2$ and the auction outcome is inefficient.

What is the likely empirical relevance of the case where the coalition wins and $v_1 < v_2$? Since the private valuation of the winning bidder is unobservable, this question can be assessed only indirectly. One possibility is to evaluate the post-bankruptcy performance of the auctioned firm. With the sample used here, Eckbo and Thorburn (2003) find that the operating performance is at par with the restructured firms' industry rivals. Thus, it appears that the typical winning bidder is able to run the restructured firm as skillfully as its industry rivals.

In this context, it is also interesting to compare the effect of alternative (second-best) bankruptcy systems. For example, Hotchkiss and Mooradian (2003) argue that a system of voluntary—as opposed to mandatory—auctions enhance efficiency. They make this argument in the context of Chapter 11 in the U.S.. The idea is that, with voluntary auctions, bidding by insiders will be less aggressive since a creditor-manager coalition will select the auction mechanism only when its own valuation is low. Knowing the insiders' selection rule, relatively efficient outside bidders are encouraged to participate in the auction when it is allowed to take place. The evidence in Hotchkiss and Mooradian (1998) shows that takeovers in Chapter 11 generate substantial wealth gains, which is consistent with the efficiency argument.

However, for the argument of Hotchkiss and Mooradian (2003) to support a system of voluntary over mandatory auctions, one must also assume that Chapter 11 restructurings are themselves efficient. It is well known that Chapter 11 grants management considerable control rights in these reorganizations. Management may use such control rights to force inefficient reorganizations where they retain their positions. Consistent with this less charitable view of Chapter 11 proceedings, we know that the vast majority of Chapter 11 cases are *not* permitted to be sold in an open auction and, as reported by e.g. Hotchkiss (1995), firms emerging from Chapter 11 restructurings tend to significantly underperform their respective industries.

Yet another empirical angle to tackle the efficiency question is to look at the ability of the auction system to promote survival of the bankrupt firm as a going concern. Does the Swedish system produce excessive liquidations? The answer is "no" if one compares the evidence across bankruptcy codes. As first documented by Thorburn (2000), three-quarters of the auctioned firms in Sweden survive as going-concern (see also Table 3). This survival rate is similar to that reported for Chapter 11 cases, but greater than the survival rate in the U.K. system. As analyzed by Franks and Nyborg (1996), the U.K. gives creditors a major influence on the ultimate allocation of the bankrupt firm's assets, which may result in excessive liquidations. Franks and Sussman (2002) find that less than half of filing firms survive the UK bankruptcy process.[36]

The going-concern survival rate is linked to the effectiveness of the restructuring process as well as to the quality of the firm at the time of bankruptcy filing. One criticism of a mandatory bankruptcy auction system is that the "hard" constraint on management may produce inefficient risk-shifting and attempts to delay filing (e.g., Aghion, Hart, and Moore (1992), Franks, Nyborg, and Torous (1996), White (1996), Hart (2000)).[37] The managerial constraint is hard indeed: In Eckbo and Thorburn (2003) we report that only one-third of the CEOs are rehired by the buyer in the auction, and the median CEO experience an income loss of 40% over the two-year period following the year of bankruptcy filing. However, in Eckbo and Thorburn (2003), we also argue that the possibility of being rehired by the buyer in the auction counteracts risk-shifting incentives and may induce firm-value maximizing behavior prior to filing. We report supporting empirical evidence using the determinants of the rehiring probability.

Overall, the mounting evidence on debt recovery, auction premiums, firm survival rates, and post-bankruptcy performance in Swedish bankruptcy auctions indicates that the reorganized firms are generally "healthy" relative to their non-bankrupt industry peers, thus supporting a common notion of economic efficiency.[38]

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[36]Recovery rates in Sweden also do not appear to be inferior to those in Chapter 11. In Table 3, we report debt recovery rates that average 39% for going concern sales, which compares to 41% median recovery reported by Franks and Torous (1994) for a sample of Chapter 11 firms with data on the market value of the claims distributed in the reorganization.

[37]Ex ante overinvestment in risky projects reduces the going-concern value of the ex post bankrupt firm. If you bet and win, you avoid bankruptcy. If you bet and lose, you file for bankruptcy.

[38]Berkovitch, Israel, and Zender (1997, 1998) argue in favor of "softening" a mandatory bankruptcy auction system

8 Conclusions

The attractiveness of the auction mechanism for restructuring bankrupt firms as going concerns depends in general on market liquidity conditions and the degree of competition among bidders. With a sample of 263 Swedish mandatory bankruptcy auctions from the period 1/1988–12/1991, we investigate bidder frequencies and determinants of final auction premiums. Since the auction mechanism is automatic, the sample allows interesting tests of the potential for fire-sale conditions to lower auction premiums. We also develop and test a theoretical model which points to the incentive of the bankrupt firm's bank (effectively the residual claimant of the firm) to add liquidity and increase auction prices.

The theoretical analysis starts with the observation that in Sweden, banks are prohibited from bidding directly in the auction. However, the banks of the filing firms frequently finance a bidder. We show that the bank-bidder coalition effectively gets around the institutional constraint on bank bidding. The coalition optimally bids above the coalition-bidder's own private valuation of the bankrupt firm (coalition overbidding). Several factors affect the feasibility of coalition formation and the magnitude of overbidding:

> **Theoretical results:** *(1) The optimal coalition bid (i) equals the price of a monopolist seller if the bank is the sole senior creditor and it does not expect full recovery from the auction, (ii) is lower the greater the expected recovery rate, and (iii) is lower the greater the number of creditors in the same priority class as the bank. (2) Coalition formation and overbidding is more likely when the bank's loan is personally guaranteed by the management of the bidder firm.*

As to item (1), maximum (unrestricted) overbidding occurs when the bank is the sole residual claimant, and it does not expect full recovery from the sale of the firm. The overbidding amount is lower if the bank expects full repayment in a piecemeal liquidation, or if it must share the auction proceeds with members of its debt class. As to item (2), if the incumbent management has issued a personal loan guarantee to the bank, the management has its own incentive to overbid (to reduce

to avoid managerial under-investment in firm-specific human capital. Aghion, Hart, and Moore (1992) suggest a simpler solution: "If the state-provided bankruptcy mechanism is harsh, it seems relatively easy for a firm to soften it ex ante. If those people choosing the corporation's financial structure wish to protect managers from bankruptcy, they can do so by choosing a low debt-equity ratio." Another solution is to offer management a side-payment in bankruptcy.

its liability). This in turn reduces the minimum transfer from the bank necessary to induce bidder participation in the coalition.

The empirical analysis has two parts. The first describes bid frequencies, patterns in bank-financing of the winning bidder, and average auction premiums. The results are summarized as follows:

> **Empirical results 1:** *(1) The average number of actual bidders (and bidders expressing serious interest in placing a bid) is 10 (and 11) in auctions resulting in piecemeal liquidation, 3 (6) across all going-concern auctions, and 3 (5) in going-concern auctions resulting in a saleback to the old owners/managers. (2) Bank financing of the winning bidder occurs in 48% of the going-concern sales in 49% of the salebacks. (3) The going-concern premium paid by the winning bidder (final price divided by the trustee's estimate of the firm's piecemeal liquidation value, minus one) averages 8% for piecemeal liquidations, 125% for going-concern sales, and 131% for going-concern auctions resulting in a saleback.*

Item (1) shows that the auctions generate bidder competition, also in salebacks. Item (2) shows that the propensity for the bank to finance the winning bidder is substantial, and no greater for salebacks than for going-concern auctions where the firm is sold to outside investors. Item (3) shows that the going-concern premium paid by the winning bidder is no smaller in salebacks than in sales to outside investors. Collectively, these three items indicate that the process leading to a saleback faces similar bidder competition and scrutiny as sales to outside investors. The premium evidence also runs counter to the argument that salebacks involve self-dealing.

The 8% average premium in auctions resulting in piecemeal liquidation indicates that the trustee's estimate of the piecemeal liquidation value (which is announced at the beginning of the auction) is unbiased for the piecemeal liquidation price paid at the end of the auction. Thus, deflating the final price paid in a going-concern sale with the initial piecemeal liquidation value estimate provides an unbiased estimate of the going-concern premium paid. In the second part of our empirical analysis, we run cross-sectional regressions with this going-concern premium as dependent variable. The explanatory variables are given by our overbidding theory as well as by asset-fire sale arguments.

The key variable from the overbidding theory is the bank's recovery rate at the piecemeal liquidation value estimate, R_L, which is observable at the beginning of the auction. The lower R_L, the greater the bank's incentive to overbid and the greater the predicted going-concern premium paid by the winner in the auction. The key fire-sale variables are the degree of industry-wide distress and the recent (six-month) change in the business cycle.[39] If the auction is impacted by fire-sale conditions, we expect auction premiums to be lower the greater the industry-wide distress and following a business cycle downturn. The results are as follows:

> **Empirical results 2**: *(1) In cross-sectional regressions with the auction premium as dependent variable, the coefficient estimate on R_L is significantly negative for going-concern sales, zero for piecemeal liquidation outcomes, and unaffected by whether or not the regression includes fire-sales variables. (2) Fire-sales variables receive insignificant coefficient estimates, also when using the piecemeal liquidation value estimate itself as dependent variable. (3) The conclusions concerning the overbidding theory and the fire-sale hypothesis are robust to a two-step (Heckman) correction for a potential self-selection bias due to the prepack filing choice. (4) Multinomial probability estimation indicates that going-concern auctions and salebacks are more likely following a business cycle upturn, while the probability of bank financing of the winning bidder is independent of fire-sale conditions. (5) There is little evidence of a conflict of interest between the bank and junior creditors in saleback transactions.*

The evidence in item (1) is consistent with the prediction of the overbidding theory. The evidence in items (2) and (3) fail to support the hypothesis that fire-sale conditions impact auction premiums. This conclusion is robust with respect to the potential effect of fire-sale conditions on the piecemeal liquidation estimate itself, and to potential selection bias from a prepack filing decision. Multinomial logit estimation shows that going-concern auctions (relative to prepacks and piecemeal liquidations) are more likely following a business cycle upturn. This also suggests that prepacks in part are selected to counteract conditions of low market demand.

Do automatic auctions promote economic efficiency? Overall, it appears from the empirical evidence that prior warnings of inefficiencies due to illiquidity, conflicts of interests, and the hard

[39]The actual number of bids, and a dummy for case where the buyer is an industry outsider were also included but without affecting the conclusions.

constraint on management implied by the auction system may have been overstated. Relative to the structured bargaining system of Chapter 11, where incumbent management are given substantial control rights, the market-oriented auction system may very well lead to a more efficient allocation of corporate resources.

A Proof of Proposition 2

The proof involves showing that $\partial E(p_c)/\partial R_L < 0$ and that $\partial E(P - V_L)/\partial p_c > 0$.[40] First, using the integral limits defined in Proposition 1, we have that

$$E(p_c) = \int_0^{B-h(p_c)} [v_1 + h(p_c)]g(v_1)dv_1 + \int_{B-h(p_c)}^{B} Bg(v_1)dv_1 + \int_B^1 v_1 g(v_1)dv_1 \tag{14}$$

Replacing B with $f(R_L) \equiv V_L/R_L$, and defining $k(R_L) \equiv f(R_L) - h(p_c)$:

$$E(p_c) = \int_0^{k(R_L)} [v_1 + h(p_c)]g(v_1)dv_1 + f(R_L)[G(f(R_L)) - G(k(R_L))] + \int_{f(R_L)}^1 v_1 g(v_1)dv_1 \tag{15}$$

The first-order condition with respect to R_L is

$$\begin{aligned}\frac{\partial E(p_c)}{\partial R_L} &= [k(R_L) + h(p_c)]g(k(R_L))k'(R_L) + f'(R_L)[G(f(R_L)) - G(k(R_L))] \\ &\quad + f(R_L)[g(f(R_L))f'(R_L)) - g(k(R_L))k'(R_L)] - f(R_L)g(f(R_L))f'(R_L)\end{aligned} \tag{16}$$

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

$$\frac{\partial E(p_c)}{\partial R_L} = f'(R_L)[G(f(R_L)) - G(k(R_L))] < 0 \tag{17}$$

Second, the expected going-concern premium paid in the auction, $E(P - V_L)$, equals the expected revenue to the bank from (unconstrained) coalition bidding (areas $C + D + E$ in Figure 1):

$$E(P - V_L) = \int_0^1 \{\int_0^{p_c(v_1)} p_2 g(p_2)dp_2 + p_c(v_1)[1 - G(p_c)]\ \}\ g(v_1)dv_1 = \int_0^1 I(p_c)g(v_1)dv_1. \tag{18}$$

To conclude that $\partial E(P - V_L)/\partial p_c > 0$ it is sufficient to show that $\partial I(p_c)/\partial p_c > 0$:

$$\frac{\partial I(p_c)}{\partial p_c} = p_c g(p_c) + [1 - G(p_c)] - p_c g(p_c) = 1 - G(p_c) > 0. \tag{19}$$

[40] The derivatives are equal to zero for the highest type, $v_1 = 1$, which we ignore.

References

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

Berkovitch, Elazar, Ronen Israel, and Jamie Zender, 1997, Optimal bankruptcy law and firm-specific investments, *European Economic Review* 41, 487–497.

——— , 1998, The design of bankruptcy law: Management bias in bankruptcy reorganizations, *Journal of Financial and Quantitative Analysis* 33, 441–464.

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

——— , and Karin S. Thorburn, 2004, Takeover bidding and the toehold puzzle, Working paper, Dartmouth College, NH.

Brown, David T., 1989, Claimholder incentive conflicts in reorganization: The role of bankruptcy law, *Review of Financial Studies* 2, 109–123.

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

Bulow, J., and J. Shoven, 1978, The bankruptcy decision, *Bell Journal of Economics* 9, 436–445.

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

Dahiya, Sandeep, Kose John, Manju Puri, and Gabriel Ramirez, 2003, Debtor-in-possession financing and bankruptcy resolution: Empirical evidence, *Journal of Financial Economics* 69, 259–280.

Eckbo, B. Espen, 2001, Anatomy of a failed bankruptcy auction, Mimeo, Center for Corporate Governance, Tuck School of Business at Dartmouth.

——— , Vojislav Maksimovic, and Joseph Williams, 1990, Consistant estimation of cross-sectional models in event studies, *Review of Financial Studies* 3, 343–365.

Eckbo, B. Espen, and Karin S. Thorburn, 2003, Control benefits and CEO discipline in automatic bankruptcy auctions, *Journal of Financial Economics* 69, 227–258.

Eckbo, B. Espen Eckbo, and Karin S. Thorburn, 2004, Resolution of financial distress in an auction bankruptcy environment, Working paper, Dartmouth College, NH.

Fishman, Michael J., 1988, A theory of preemptive takeover bidding, *RAND Journal of Economics* 19, 88–101.

Franks, Julian, Kjell Nyborg, and Walter Torous, 1996, A comparison of US, UK and German insolvency codes, *Financial Management* 25, 86–101.

Franks, Julian, and Kjell G. Nyborg, 1996, Control rights, debt structure, and the loss of private benefits: The case of the U.K. insolvency code, *Review of Financial Studies* 9, 1165–1210.

Franks, Julian, and Oren Sussman, 2002, Financial distress and bank restructuring of small to medium size UK companies, Working Paper, London Business School.

Franks, Julian, and Walter Torous, 1989, An empirical investigation of U.S. firms in reorganization, *Journal of Finance* 44, 747–770.

——— , 1994, A comparison of financial recontracting in distressed exchanges and Chapter 11 reorganizations, *Journal of Financial Economics* 35, 349–370.

Gertner, Robert H., and David S. Scharfstein, 1991, A theory of workouts and the effects of reorgaization law, *Journal of Finance* 46, 1189–1222.

Hart, Oliver, 2000, Different approaches to bankruptcy, Working paper, Harvard University, MA.

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

Hotchkiss, Edith, 1995, Post-bankruptcy performance and management turnover, *Journal of Finance* 50, 3–21.

——— , and Robert M. Mooradian, 1998, Acquisitions as a means of restructuring firms in Chapter 11, *Journal of Financial Intermediation* 7, 240–262.

——— , 2003, Auctions in bankruptcy, *Journal of Corporate Finance* 9, 555–574.

Jensen, Michael C., and William Meckling, 1976, Theory of the firm: Managerial behavior, agency costs, and capital structure, *Journal of Financial Economics* 3, 305–360.

Judge, G. G., R. C. Hill, W. E. Griffiths, H. Lutkepohl, and T-C Lee, 1988, *Introduction to the Theory and Practice of Econometrics* ((2nd ed.) Wiley, New York).

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

LoPucki, Lynn, and W. Whitford, 1993, Corporate governance in the bankruptcy reorganization of large, publicly held companies, *University of Pennsylvania Law Review* 141, 669–800.

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

Myers, Stewart C., 1977, Determination of corporate borrowing, *Journal of Financial Economics* 4, 147–175.

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

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

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

Strömberg, Per, 2000, Conflicts of interests and market illiquidity in bankruptcy auctions: Theory and tests, *Journal of Finance* 55, 2641–2692.

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

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

Weiss, Lawrence, 1990, Bankruptcy resolution: direct costs and violations of priority of claims, *Journal of Financial Economics* 27, 285–314.

White, Michelle, 1984, Bankruptcy liquidation and reorganization, in Dennis Logue, and James Seward, ed.: *Handbook of Modern Finance* . chap. E7, pp. 1–44 (Warren, Gorham & Lamont).

——— , 1996, The cost of corporate bankruptcy: A U.S.-European comparison, in Jagdeep Bhandari, and Lawrence Weiss, ed.: *Corporate Bankruptcy: Economic and Legal Perspectives* . chap. 30, pp. 467–500 (Cambridge University Press).

Table 1: Key provisions of the Swedish auction bankruptcy system

Provision	Rules under Swedish auction bankruptcy	Rules under U.S. Chapter 11
Right to file for bankruptcy:	The firm or any individual creditor.	The firm or a joint filing of minimum 3 creditors with unsecured claims exceeding $ 5,000.
Control right to firm in bankruptcy:	The independent court-appointed trustee. Firm is auctioned off either piecemeal or as a going concern. All contracts (including workers) are necessarily terminated, subject to continued operations throughout the auction procedure. If sold as a going concern, buyer negotiates contract continuation	Incumbent management. A trustee takes control only in case of mis-management or fraud. Management has an exclusive right to propose a reorganization plan during the first 120 days, plus an additional 60 days to seek acceptance. Termination of contracts is at the discretion of firm.
Voting rules to approve of reorganization:	None. Firm is auctioned off.	1/2 in number of votes and 2/3 in value of the claims in the debt class.
Payment method:	Cash only.	Cash and securities, including common stock.
Absolute priority rules:	No deviations allowed.	Deviations frequently observed.
Seizure of collateral by secured creditors:	No seizure, except in very limited circumstances when the collateral is in the creditor's physical possession.	No seizure. All creditors are stayed.
Debt service during the proceeding:	Yes, on secured debt if the value of collateral is sufficiently high.	Yes, on secured debt if the value of collateral is sufficiently high.
Accrual of interest during the proceeding:	No. Interest and principal payments stop.	No. Interest and principal payments stop.
Debtor-in-possession financing in bankruptcy:	Yes. New debt with super priority can be raised, however, is rarely observed.	Yes. New debt with super priority can be raised and is frequently observed.
Government wage guarantee:	Yes, up to a certain limit.	No guarantee.

Table 2: Swedish bankruptcy sample description, 1988-1991

	Total sample		Auction prepack			Going-concern auction			Piecemeal liquidation
	All	(%)	All[1]	Saleback	Non-saleback	All[1]	Saleback	Non-saleback	All
Manufacturing	76	(29)	17	11	4	44	28	16	15
Wholesale and Retail	46	(17)	13	8	3	24	13	11	8
Construction	33	(13)	4	2	2	22	18	4	7
Transportation	29	(11)	3	2	1	12	8	3	14
Hotels and Restaurants	26	(10)	9	5	4	12	4	8	5
Consulting	21	(8)	1	1	0	14	8	5	4
Real estate	12	(5)	2	1	1	5	2	2	5
Miscellaneous	20	(8)	4	2	2	14	9	5	2
Total	263	(100)	53	32	17	147	90	54	60

[1] Due to missing information on the identity of the buyer, the category "All" contains more cases than the sum of the subcategories "Saleback" and "Non-saleback".

Table 3: Bid frequencies, bank financing, auction premiums, and recovery rates

		Total sample	Going-concern auction			Auction prepack			Piecemeal liquidation
		All	All[1]	Saleback	Non-saleback	All[1]	Saleback	Non-saleback	All
A: Bid information									
Number of interested bidders [*Interest*]	Average	5.5	5.7	5.3	6.1	1.2	1.2	1.1	11.4
	Median	3.0	3.0	3.0	4.0	1.0	1.0	1.0	5.0
	N	156	102	55	46	33	24	8	20
Number of actual bids [*Bids*]	Average	3.6	3.2	3.0	3.5	1.2	1.2	1.0	9.8
	Median	2.0	2.0	2.0	3.0	1.0	1.0	1.0	5.0
	N	146	95	52	42	33	24	8	17
B: Bank financing									
Cases where the old bank finances the winning bidder[2] [*Bankfin*]	Number	64	44	31	13	20	15	5	n/a
	Total	132	95	63	31	35	24	10	
	Percent	48%	46%	49%	42%	57%	62%	50%	
C: Premiums and recovery rates									
Going-concern premium[3,4] $[(P/V_L^a)-1]$	Average	0.92	1.25	1.31	1.20	n/a	n/a	n/a	0.08
	Std err	0.18	0.24	0.30	0.44				0.08
	N	188	135	83	50				50
Debt recovery rate	Average	0.34	0.39	0.38	0.41	0.32	0.29	0.37	0.26
	Std err	0.01	0.02	0.02	0.02	0.03	0.04	0.06	0.03
	N	263	147	90	54	53	32	17	60
Bank liquidation recovery rate[4] [R_L]	Average	0.60	0.66	0.67	0.63	n/a	n/a	n/a	0.45
	Std err	0.03	0.03	0.04	0.05				0.05
	N	198	141	88	50				55

[1] Due to missing information on the identity of the buyer, the category "All" contains more cases than the sum of the subcategories "Saleback" and "Non-saleback".
[2] Proportion going concern-auctions and prepacks in which the filing firm's bank versus a new bank financed the winning bid.
[3] The difference between the price paid in the auction P and the trustee's estimate of the piecemeal liquidation value of the auctioned assets V_L^a.
[4] In prepacks, the trustee typically does not report the estimate V_L, hence the missing information on the auction premium and R_L.

Table 4: Variable definitions

Variable name	Definition
A: Variables for tests of overbidding	
R_L	Bank's liquidation recovery rate $R_L \in [0,1]$, obtained if the auction produces proceeds equal to the trustee's estimate of the firm's piecemeal liquidation value (V_L).
Piecemeal	Binary variable indicating that the firm is liquidated piecemeal (x_j=1) vs. sold as going concern in the auction or in a prepack (x_j=0).
B: Variables for tests of asset fire-sales	
Distress	Fraction of all Swedish firms with at least 20 employees and the same 4-digit SIC code as the sample firm that either reports an interest coverage ratio (the sum of EBITDA and interest income divided by interest expense) of less than one or files for bankruptcy in the calendar year of the sample firm's bankruptcy filing.
Δ*Cycle*	Change in the equal-weighted quarterly index of the gross national product (+), the producer price index (+), aggregate consumption (+), unemployment rate (-) and number of corporate bankruptcy filings (-). The variables are normalized with their mean and standard deviation before entering the index with the sign indicated in parenthesis.
Saleback	Binary variable indicating that the firm is sold as a going concern to the old owner (x_j=1) vs. to a new owner (x_j=0).
Bankfin	Binary variable indicating that the buyer of a going concern is financed by the filing firm's old bank (x_j=1) vs. by a new bank (x_j=0).
Bids	Number of actual bids submitted in the auction.
Interest	Number of potential bidders expressing an interest for bidding in the auction.
C: Miscellaneous control variables	
Size	Natural log of the book value of total assets as reported in the firm's last financial statement prior to filing.
Profmarg	Difference between the firm's pre-filing operating margin (EBITDA divided by sales) and the contemporaneous median operating margin for all Swedish firms with at least 20 employees and the same 4-digit SIC code as the bankrupt firm.
Secured	Fraction secured debt of the firm's total debt at filing.

Table 5: Sample (Pearson) correlations of firm and auction characteristics

A: Sample of going concern auctions and piecemeal liquidations

	Overbidding		Asset fire-sale		Misc. control variables		
	R_L	*Piecemeal*	*Distress*	*ΔCycle*	*Size*	*Profmarg*	*Secured*
R_L	1.000						
Piecemeal	-0.254***	1.000					
Distress	-0.086	0.082	1.000				
ΔCycle	-0.057	-0.134*	0.106	1.000			
Recovery	0.393***	-0.287***	0.040	-0.016			
Size	-0.049	-0.021	-0.048	-0.094	1.000		
Profmarg	-0.075	-0.077	0.016	0.029	0.023	1.000	
N	196	207	207	207	205	204	207

B: Sample of going concern auctions

	Over-bidding	Asset fire-sale variables					
	R_L	*Distress*	*ΔCycle*	*Saleback*	*Bankfin*	*Bids*	*Interest*
R_L	1.000						
Distress	-0.076	1.000					
ΔCycle	-0.070	0.131	1.000				
Saleback	0.054	-0.053	0.129	1.000			
Bankfin	0.068	0.040	-0.018	0.069	1.000		
Bids	-0.089	-0.089	0.011	-0.063	0.076	1.000	
Interest	-0.007	0.010	-0.029	-0.060	0.007	0.625***	1.000
N	141	147	147	144	95	95	102

1 ***, ** and * indicates significantly different from zero at the 1%, 5% and 10% level (two-tailed test), respectively.

Table 6: Tests of the overbidding hypothesis: H1(i)-H1(iii)

The table reports OLS coefficient estimates in regressions with the auction premium $\ln(P/V_L^a)$ as dependent variable. p-values (and the degrees of freedom for R^2) are in parentheses.

	Overbidding variables				Competition			Misc. control variables					
Constant	*Piecemeal*	R_L	R_L* *Piecemeal*	R_L* *Concern*	*Bids*	*Interest*	*>2Bids*	*Size*	*Profmarg*	*Secured*	*Adj. R^2*	*F-value*	*N*
A: Total sample of 173 going-concern auctions and piecemeal liquidations													
0.913 (0.354)	-0.579 (0.000)	-0.881 (0.000)						0.018 (0.776)	-0.049 (0.910)	-0.647 (0.035)	0.142 (df=5)	6.748 (0.000)	173
1.185 (0.225)	-1.122 (0.000)		-0.133 (0.704)	-1.134 (0.000)				0.013 (0.836)	0.028 (0.948)	-0.691 (0.023)	0.169 (df=6)	6.849 (0.000)	173
1.185 (0.225)	-1.122 (0.000)	-1.134 (0.000)	1.001 (0.013)					0.013 (0.836)	0.028 (0.948)	-0.691 (0.023)	0.169 (df=6)	6.849 (0.000)	173
B: Sample of 118 going-concern auctions and piecemeal liquidations restricted to cases where R_L<1													
0.833 (0.490)	-0.716 (0.000)	-0.806 (0.003)						0.031 (0.697)	-0.138 (0.768)	-0.848 (0.025)	0.177 (df=5)	6.060 (0.000)	118
0.885 (0.461)	-1.094 (0.000)		-0.182 (0.704)	-1.006 (0.001)				0.036 (0.639)	-0.035 (0.940)	-0.893 (0.018)	0.187 (df=6)	5.524 (0.000)	118
0.885 (0.461)	-1.094 (0.000)	-1.066 (0.001)	0.885 (0.120)					0.036 (0.639)	-0.035 (0.940)	-0.893 (0.018)	0.187 (df=6)	5.524 (0.000)	118
C: Sample of 130 going-concern auctions													
0.867 (0.460)		-1.119 (0.000)						0.038 (0.612)	-0.046 (0.960)	-0.958 (0.010)	0.139 (df=4)	6.235 (0.000)	130
2.077 (0.123)		-1.218 (0.000)			-0.038 (0.118)			-0.028 (0.735)	0.729 (0.501)	-0.816 (0.084)	0.188 (df=5)	4.932 (0.001)	85
1.929 (0.143)		-1.174 (0.000)				-0.029 (0.022)		-0.009 (0.911)	0.631 (0.550)	-1.111 (0.014)	0.205 (df=5)	5.643 (0.000)	90
1.969 (0.149)		-1.257 (0.000)					-0.092 (0.596)	-0.023 (0.790)	0.620 (0.574)	-0.918 (0.054)	0.165 (df=5)	4.370 (0.001)	85

Table 7: Tests of the overbidding hypothesis: H1(iv)

The table reports OLS coefficient estimates in regressions with the auction premium ln(P/V_L^a) as dependent variable. p-values (and the degrees of freedom for R^2) are in parentheses. Sample of 84 going-concern auctions.

	Overbidding variables				Competition		Misc. control variables					
Constant	*Bankfin*	R_L	R_L* *Bankfin*	R_L* *NoBankfin*	*Bids*	*Interest*	*Size*	*Profmarg*	*Secured*	*Adj. R²*	*F-value*	*N*
2.102 (0.117)			-1.215 (0.000)	-1.402 (0.000)			-0.038 (0.659)	-0.329 (0.738)	-0.483 (0.261)	0.237 (df=5)	6.290 (0.000)	84
2.523 (0.112)			-1.510 (0.000)	-1.742 (0.000)	-0.050 (0.334)		-0.025 (0.803)	-0.906 (0.458)	-1.283 (0.032)	0.278 (df=6)	4.533 (0.001)	55
2.425 (0.126)			-1.319 (0.000)	-1.645 (0.000)		-0.018 (0.562)	-0.023 (0.821)	-0.610 (0.603)	-1.418 (0.014)	0.267 (df=6)	4.459 (0.001)	57
1.695 (0.210)	0.362 (0.031)	-1.339 (0.000)					-0.023 (0.782)	-0.704 (0.473)	-0.457 (0.280)	0.261 (df=5)	6.940 (0.000)	84
2.261 (0.134)	0.497 (0.020)	-1.752 (0.000)			-0.050 (0.314)		-0.017 (0.857)	-1.749 (0.153)	-1.388 (0.014)	0.346 (df=6)	5.845 (0.000)	55
2.193 (0.148)	0.496 (0.016)	-1.539 (0.000)				-0.015 (0.602)	-0.023 (0.809)	-1.171 (0.310)	-1.400 (0.011)	0.329 (df=6)	5.662 (0.000)	57
1.448 (0.273)	1.048 (0.003)		-1.870 (0.000)	-0.865 (0.007)			-0.028 (0.733)	-0.928 (0.335)	-0.447 (0.278)	0.299 (df=6)	6.967 (0.000)	84
2.243 (0.115)	1.425 (0.001)		-2.440 (0.000)	-1.066 (0.008)	-0.034 (0.468)		-0.052 (0.565)	-2.236 (0.050)	-1.177 (0.028)	0.419 (df=7)	6.668 (0.000)	55
2.180 (0.139)	1.173 (0.004)		-2.030 (0.000)	-0.997 (0.014)		-0.005 (0.851)	-0.051 (0.588)	-1.406 (0.215)	-1.213 (0.024)	0.365 (df=7)	5.690 (0.000)	57

Table 8: Robustness tests

The table reports OLS coefficient estimates in regressions with the auction premium $\ln(P/V_L^a)$ as dependent variable. p-values (and the degrees of freedom for R^2) are in parentheses.

	Overbidding variables	Misc. control variables					
Constant	R_L	*Size*	*Profmarg*	*Secured*	*Adj.* R^2	*F-value*	*N*
A: Regression with Box-Cox transformation $R_L^{(\lambda)}$. Sample of 80 going concern auctions where R_L<1							
Transformation using λ=1.53							
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)	
Transformation using λ=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)	
B: Sample of 44 piecemeal liquidations							
-0.620	-0.124	0.050	-0.103	-0.542	-0.076	0.219	44
(0.746)	(0.741)	(0.686)	(0.842)	(0.368)	(df=4)	(0.926)	

Table 9: Tests of fire-sales hypothesis: H2

The table reports OLS coefficient estimates in regressions with the auction premium $\ln(P/V_L^a)$ as dependent variable. p-values (and the degrees of freedom for R^2) are in parentheses.

	Overbidding variables			Asset-fire sale variables				Misc. control variables					
Constant	r_L	*Piecemeal*	*Bankfin*	*Distress*	*ΔCycle*	*Saleback*	*Bids*	*Size*	*Profmarg*	*Secured*	*Adj. R^2*	*F-value*	*N*
A: Sample of going concern auctions and piecemeal liquidations													
0.609	-0.862	-0.563		0.369	0.022			0.028	-0.087	-0.687	0.143	5.125	173
(0.546)	(0.000)	(0.000)		(0.365)	(0.317)			(0.662)	(0.843)	(0.026)	(df=7)	(0.000)	
-0.273		-0.474		0.265	0.022			0.040	0.055	-0.270	0.044	2.393	181
(0.795)		(0.001)		(0.520)	(0.345)			(0.549)	(0.905)	(0.354)	(df=6)	(0.030)	
B: Sample of going concern auctions													
1.237	-1.124			0.205	0.018	0.138		0.021	0.327	-0.781	0.154	4.276	126
(0.306)	(0.000)			(0.662)	(0.522)	(0.339)		(0.978)	(0.711)	(0.032)	(df=7)	(0.000)	
1.185				0.210	0.014	0.075		0.010	0.442	-0.238	-0.036	0.231	131
(0.888)				(0.687)	(0.646)	(0.636)		(0.903)	(0.647)	(0.507)	(df=6)	(0.966)	
1.446	-1.321		0.353	-0.477	0.005	0.118		0.001	-0.828	-0.505	0.267	4.818	84
(0.310)	(0.000)		(0.037)	(0.372)	(0.139)	(0.497)		(0.994)	(0.399)	(0.234)	(df=8)	(0.000)	
0.072			0.272	-0.363	0.005	0.197		0.013	0.273	0.186	-0.006	0.929	84
(0.965)			(0.164)	(0.561)	(0.169)	(0.331)		(0.898)	(0.808)	(0.695)	(df=7)	(0.489)	
1.434	-1.226			0.459	0.027	0.172	-0.011	-0.008	0.352	-0.926	0.151	2.850	83
(0.334)	(0.000)			(0.447)	(0.943)	(0.349)	(0.613)	(0.926)	(0.757)	(0.060)	(df=8)	(0.008)	
2.296	-1.611		0.476	-0.472	0.013	0.090	0.005	-0.028	-1.548	-1.265	0.300	3.625	55
(0.168)	(0.000)		(0.044)	(0.483)	(0.765)	(0.684)	(0.900)	(0.783)	(0.256)	(0.047)	(df=9)	(0.002)	
1.054			0.082	-0.271	0.062	0.374	0.100	-0.065	1.127	0.133	0.044	1.313	55
(0.579)			(0.742)	(0.729)	(0.222)	(0.134)	(0.030)	(0.576)	(0.422)	(0.829)	(df=8)	(0.260)	
C: Sample of piecemeal liquidations													
-0.938	-0.097			0.786	0.022			0.053	-0.182	-0.660	-0.096	0.360	44
(0.631)	(0.800)			(0.399)	(0.584)			(0.676)	(0.730)	(0.286)	(df=6)	(0.899)	

Table 10: Effect of fire-sale conditions on the piecemeal liquidation value estimate

The table reports OLS coefficient estimates in regressions with the trustee's piecemeal liquidation value estimate V_L as dependent variable. p-values (and the degrees of freedom for R^2) are in parentheses.

	Overbidding variables		Asset-fire sale variables				Misc. control variables					
Constant	*Piecemeal*	*Bankfin*	*Distress*	*ΔCycle*	*Saleback*	*Bids*	*Size*	*Profmarg*	*Secured*	*Adj. R^2*	*F-value*	*N*
A: Dependent variable $\ln(V_L)$. Sample of going concern auctions and piecemeal liquidations												
1.990	-1.006		0.118	0.002			0.769	-1.184	0.423	0.401	23.499	202
(0.131)	(0.000)		(0.817)	(0.935)			(0.000)	(0.031)	(0.233)	(df=6)	(0.000)	
B: Dependent variable $\ln(V_L)$. Sample of going concern auctions												
2.132			0.054	0.007	-0.036		0.765	-0.776	0.404	0.426	18.592	142
(0.101)			(0.916)	(0.817)	(0.816)		(0.000)	(0.368)	(0.244)	(df=6)	(0.000)	
1.662		0.187	-0.036	-0.001	-0.259		0.810	-2.008	-0.039	0.463	12.679	95
(0.306)		(0.325)	(0.955)	(0.968)	(0.193)		(0.000)	(0.066)	(0.932)	(df=7)	(0.000)	
1.399		0.512	-0.412	-0.072	-0.179	-0.056	0.837	-3.326	-0.222	0.535	10.046	63
(0.445)		(0.027)	(0.570)	(0.114)	(0.447)	(0.195)	(0.000)	(0.010)	(0.696)	(df=8)	(0.000)	
C: Dependent variable V_L/A. Sample of going concern auctions and piecemeal liquidations												
-1.600	-0.994		0.186	0.014				-1.170	0.101	0.129	6.997	202
(0.000)	(0.000)		(0.720)	(0.633)				(0.036)	(0.767)	(df=5)	(0.000)	
D: Dependent variable V_L/A. Sample of going concern auctions												
-1.493			0.039	0.020	-0.026			-0.839	0.062	-0.026	0.289	142
(0.000)			(0.941)	(0.507)	(0.870)			(0.344)	(0.852)	(df=5)	(0.918)	
-1.329		0.229	0.007	0.007	-0.207			-2.110	-0.380	0.005	1.083	93
(0.001)		(0.242)	(0.991)	(0.853)	(0.312)			(0.061)	(0.390)	(df=6)	(0.379)	
-1.176		0.548	-0.255	-0.076	-0.136	-0.067		-3.303	-0.554	0.091	1.870	61
(0.018)		(0.023)	(0.733)	(0.116)	(0.573)	(0.138)		(0.014)	(0.318)	(df=7)	(0.093)	

Table 11: Premium regressions with correction for auction prepack selection

The table reports OLS coefficient estimates in regressions with the auction premium $\ln(P/V_L^a)$ as dependent variable. The variable $\phi(\gamma'Z)/\Phi(\gamma'Z)$ is constructed from a probit regression for the decision to file a prepackaged bankruptcy filing.[1] p-values (and the degrees of freedom for R^2) are in parentheses.

	Overbidding variables			Asset-fire sale variables				Misc. control variables						
Constant	r_L	*Piecemeal*	*Bankfin*	*Distress*	*ΔCycle*	*Saleback*	*Bids*	*Size*	*Profmarg*	*Secured*	$\frac{\phi(\gamma'Z)}{\Phi(\gamma'Z)}$	*Adj. R²*	*F-value*	*N*
A: Sample of going concern auctions and piecemeal liquidations														
-0.690	-0.879	-0.558		0.800	0.021			0.175	0.353	-1.599	-2.429	0.148	4.728	173
(0.816)	(0.000)	(0.000)		(0.377)	(0.344)			(0.599)	(0.729)	(0.458)	(0.651)	(df=8)	(0.000)	
-1.525		-0.463		0.685	0.020			0.179	0.483	-1.141	-2.279	0.040	2.061	181
(0.619)		(0.001)		(0.472)	(0.410)			(0.603)	(0.650)	(0.611)	(0.682)	(df=7)	(0.050)	
B: Sample of going concern auctions														
-4.488	-1.190			2.029	0.016	0.126		0.673	2.555	-5.140	-11.095	0.188	4.600	126
(0.201)	(0.000)			(0.068)	(0.540)	(0.366)		(0.092)	(0.090)	(0.050)	(0.087)	(df=8)	(0.000)	
-2.824				1.190	0.012	0.053		0.356	1.714	-2.457	-5.655	-0.039	0.313	131
(0.470)				(0.328)	(0.698)	(0.733)		(0.420)	(0.310)	(0.393)	(0.426)	(df=7)	(0.947)	
-0.765	-1.381		0.356	0.280	0.055	0.111		0.254	0.102	-2.075	-4.159	0.322	5.322	84
(0.872)	(0.000)		(0.027)	(0.843)	(0.079)	(0.495)		(0.638)	(0.960)	(0.563)	(0.629)	(df=9)	(0.000)	
-1.667			0.294	0.251	0.055	0.177		0.200	1.063	-0.916	-2.973	-0.002	0.981	81
(0.774)			(0.128)	(0.884)	(0.150)	(0.369)		(0.761)	(0.664)	(0.833)	(0.776)	(df=8)	(0.458)	
-2.714	-1.273			1.839	0.003	0.149	-0.031	0.486	2.136	-4.004	-8.347	0.205	3.319	83
(0.517)	(0.000)			(0.174)	(0.922)	(0.394)	(0.185)	(0.308)	(0.225)	(0.200)	(0.285)	(df=9)	(0.002)	
3.123	-1.781		0.491	-0.502	0.028	-0.017	-0.053	-0.089	-1.766	-0.770	0.811	0.390	4.388	55
(0.588)	(0.000)		(0.019)	(0.769)	(0.492)	(0.933)	(0.299)	(0.891)	(0.468)	(0.858)	(0.938)	(df=10)	(0.000)	
2.306			0.183	-0.623	0.071	0.308	0.047	-0.229	0.318	1.458	3.126	-0.049	0.726	55
(0.760)			(0.474)	(0.781)	(0.183)	(0.243)	(0.460)	(0.789)	(0.919)	(0.795)	(0.820)	(df=9)	(0.682)	

[1] ϕ_i is the standard normal density and Φ_i is the cumulative normal distribution function evaluated at $\gamma'Z_i$, where $\gamma'Z_i \leq 0$ is the probit choice model for auction prepack.

Table 12: Multinomial estimates of auction outcome probabilities

Coefficient estimates in a multinomial logit estimation of the probability for bankruptcy outcomes prior to the bankruptcy. Table shows the partial derivatives of probabilities with respect to the vector of characteristics, computed at the variable means filing (p-value in parenthesis).[1]

		Asset fire-sale variables		Miscellaneous control variables		
Bankruptcy outcome:	*Constant*	*Distress*	Δ*Cycle*	*Size*	*Profmarg*	*Secured*
A. Auction prepack						
Auction prepack (π_1)	-0.742 (0.100)	0.123 (0.436)	-0.005 (0.601)	0.043 (0.119)	0.147 (0.509)	-0.302 (0.025)
Going concern auction (π_2)	0.637 (0.210)	-0.297 (0.133)	0.023 (0.061)	-0.018 (0.560)	0.082 (0.736)	0.122 (0.370)
Piecemeal liquidation (π_3)	0.105 (0.807)	0.174 (0.288)	-0.018 (0.106)	-0.024 (0.371)	-0.228 (0.226)	0.018 (0.137)
N=257, Log likelihood=-244.28, LRT=16.58, df=10 (p=0.084). Probabilities at the mean vector are 0.198, 0.580, and 0.222, respectively [2]						
B. Saleback						
Saleback (π_1)	0.255 (0.625)	-0.347 (0.107)	0.027 (0.042)	0.011 (0.736)	0.442 (0.138)	-0.236 (0.112)
Non-saleback (π_2)	-0.388 (0.418)	0.138 (0.459)	-0.008 (0.491)	0.016 (0.593)	-0.166 (0.463)	0.025 (0.843)
Piecemeal liquidation (π_3)	0.132 (0.759)	0.210 (0.224)	-0.019 (0.103)	-0.027 (0.331)	-0.276 (0.167)	0.211 (0.093)
N=250, Log likelihood= -255.12, LRT=13.59, df=10 (p=0.192). Probabilities at the mean vector are 0.484, 0.290, and 0.226, respectively [2]						
C. Bank financing of the winning bidder						
Old bank financing(π_1)	0.111 (0.845)	0.029 (0.897)	0.002 (0.881)	0.003 (0.939)	0.486 (0.135)	-0.334 (0.066)
New bank financing (π_2)	-0.558 (0.346)	-0.240 (0.311)	0.018 (0.187)	0.040 (0.275)	-0.167 (0.499)	0.088 (0.599)
Piecemeal liquidation (π_3)	0.448 (0.420)	0.211 (0.332)	-0.020 (0.148)	-0.043 (0.227)	-0.319 (0.185)	0.246 (0.144)
N=188, Log likelihood= -199.94, LRT=12.63, df=10 (p=0.245). Probabilities at the mean vector are 0.338, 0.355, and 0.307, respectively [2]						

[1] The partial derivatives are given by $\partial\pi_n / \partial z_k = \pi_n(\gamma_{kn} - \sum_{e=1}^{3}\gamma_{ek}\pi_e)$, where the multinomial logit model has the form $\pi_n(Z_i) = \exp(\gamma_n' Z_i) / \sum_{n=1}^{3}\exp(\gamma_n' Z_i)$.

[2] The likelihood ratio test (LRT) compares the performance of the model to a model with only constants. The test is distributed χ^2 with degrees of freedom equal to the total number of estimated slope coefficient (two models with five estimated slope coefficients each).

Figure 1: Expected bidding profits

The figure is drawn assuming bidder valuations are distributed uniform, $v_i \sim U[0,1]$. G(v) is the cumulative distribution over v. Bidder 2's optimal bid is $p_2=v_2$ and the coalition's optimal bid is p_c. Area A is the expected profits to Bidder 1 and C is the bank's expected profit under non-cooperative bidding. With coalition bidding, area E is bidder 1's expected cost of overbidding (when the coalition wins and pays $v_2>v_1$). Area A+C+D is the coalition's total expected profit, and area D is the coalition's expected net surplus from overbidding.

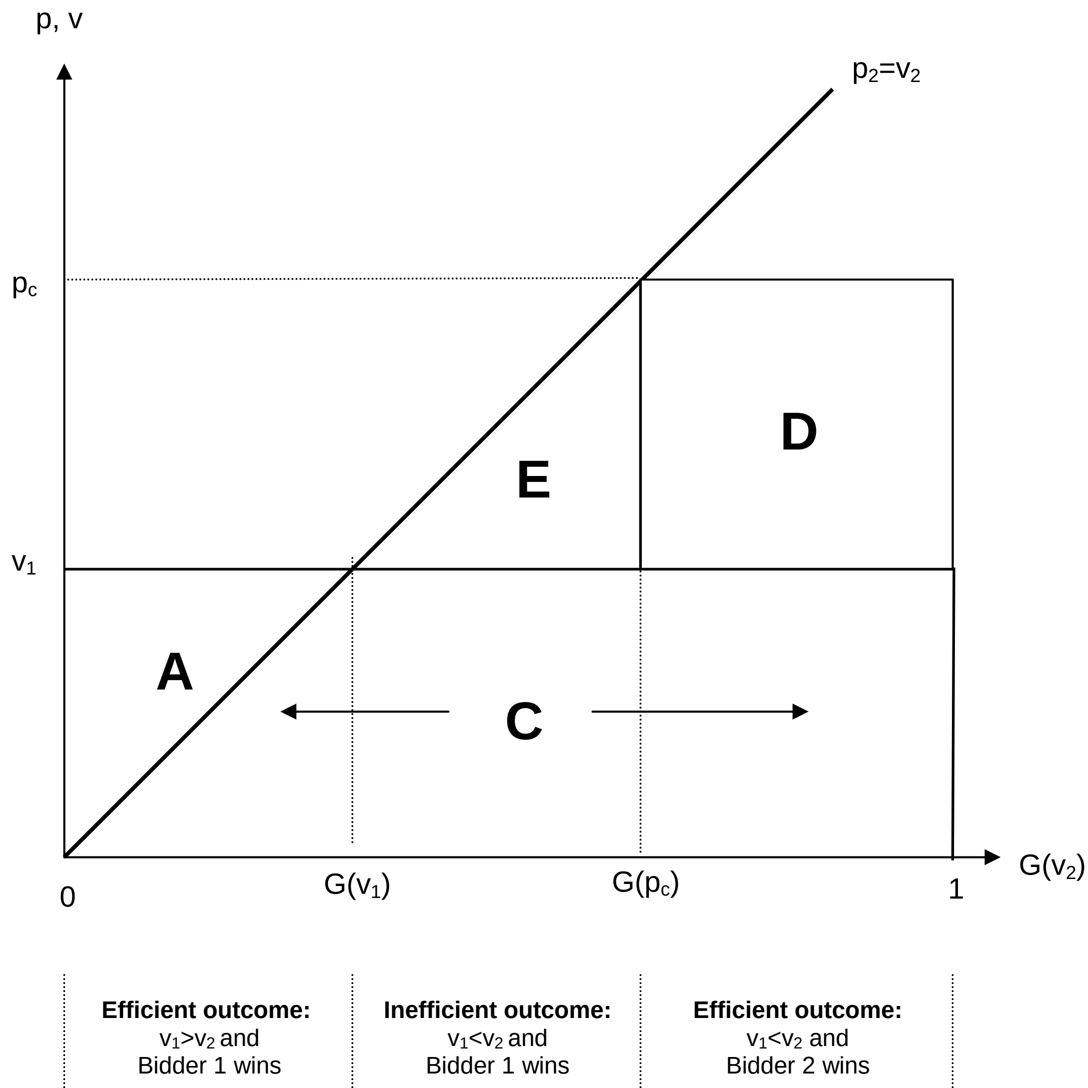

Figure 2: The bank-bidder coalition's optimal bid price $p_c(v_1)$

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

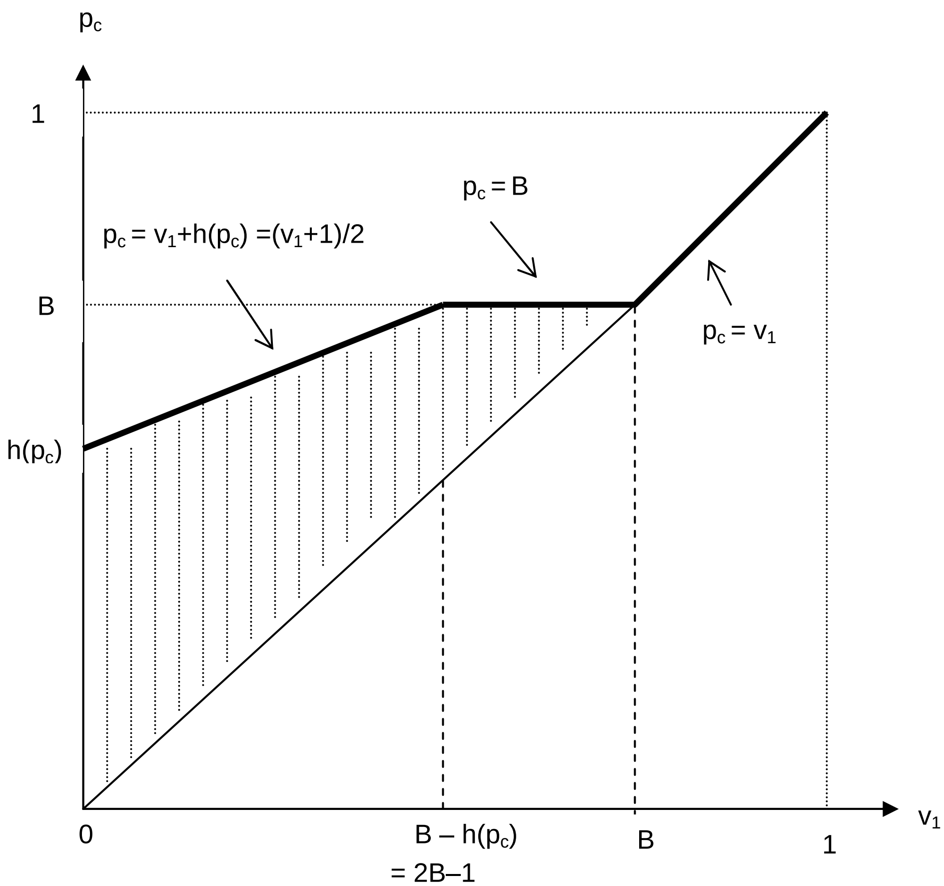

Figure 3: Frequency distributions of the number of interested bidders and actual auction bids

Sample consists of 102 (non-prepack) going concern auctions with available bid information. In the group of 13+, the maximum numbers of interested bidders and actual bids are 40 and 22, respectively.

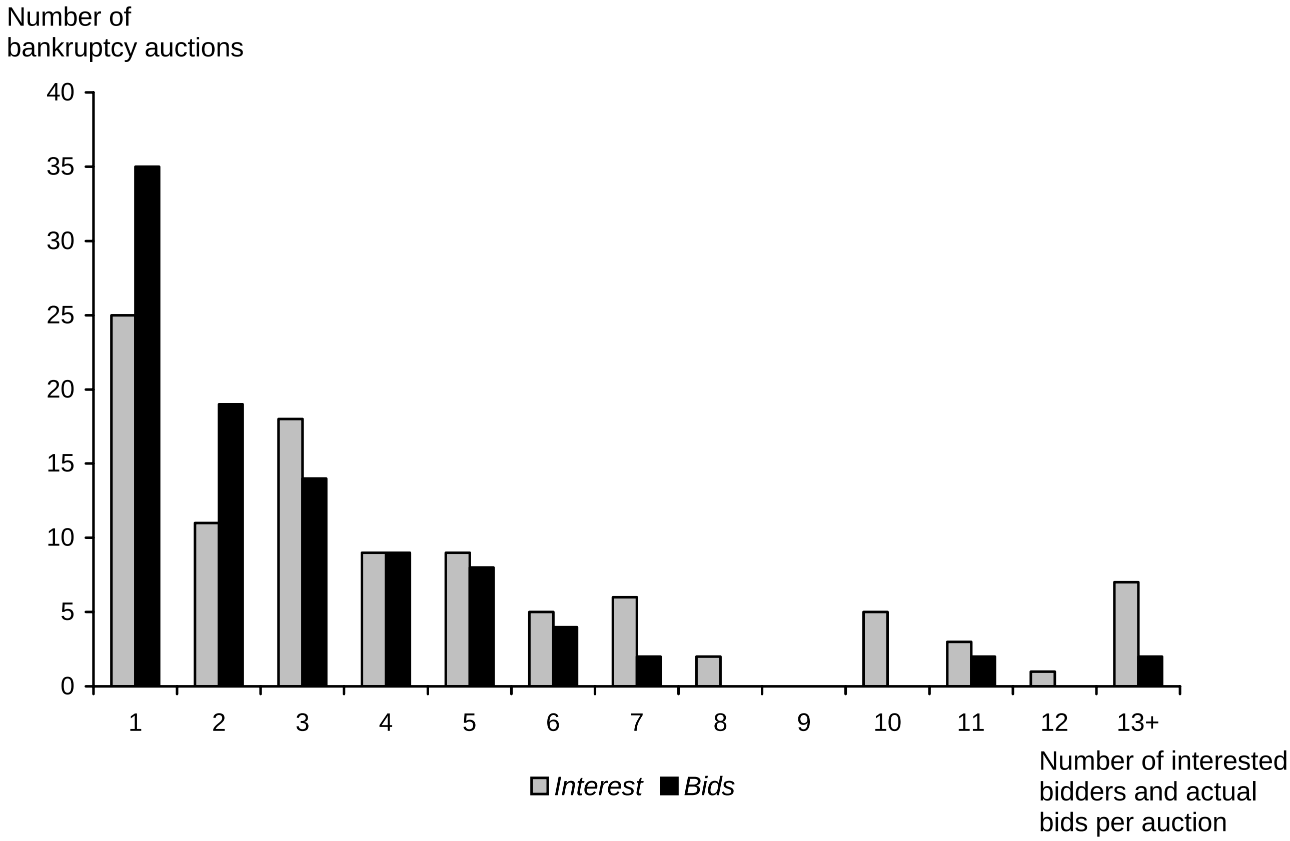

Figure 4: Frequency distribution of the piecemeal liquidation recovery rate

The piecemeal liquidation recovery rate is R_L=min[V_L/B, 1]*100%. Sample of 196 bankruptcy auctions, excluding auction prepack filings.

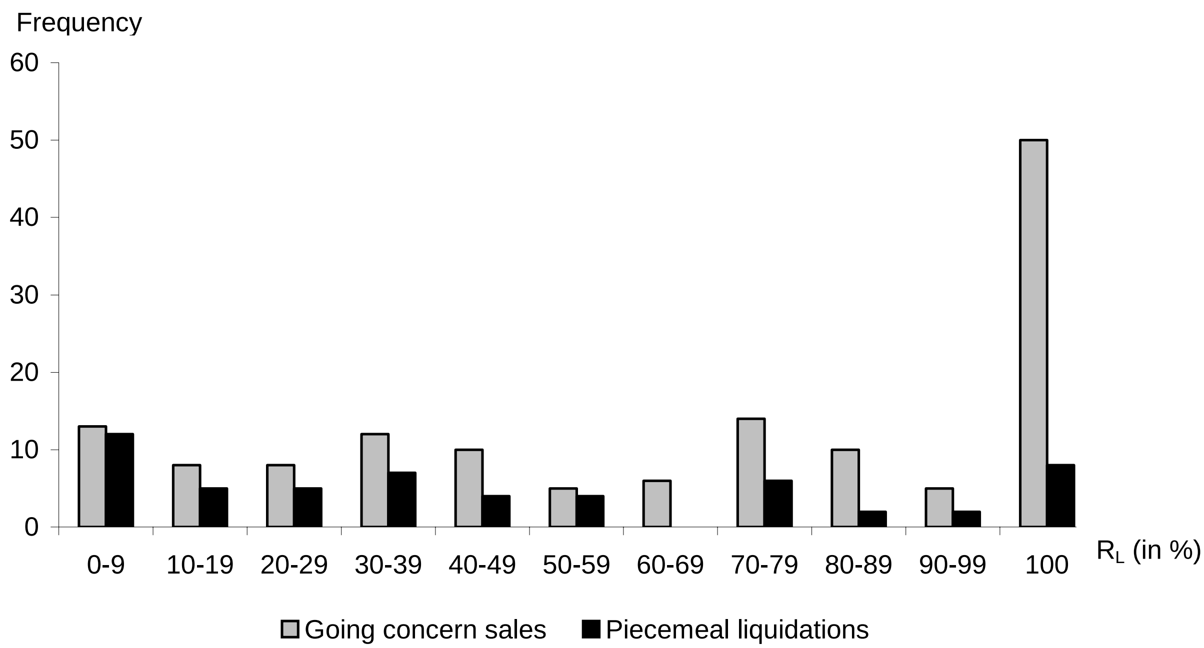

Figure 5: Overbidding and efficiency

In the bankruptcy auction, v_1 is Bidder 1's private valuation and v_2 is Bidder 2's private valuation of the bankrupt firm. The bank forms a coalition with bidder 1 and the coalition's optimal bid is p_c, where $p_c \geq v_1$ (overbidding). The auction outcome is efficient when the bankrupt firm is allocated to the highest-valuation bidder (this happens when $p_c < v_2$ or $v_1 > v_2$), and inefficient when the coalition wins the auction with a lower valuation than Bidder 2 (when $p_c \geq v_2 > v_1$).