Stapled Finance

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Abstract

Stapled Finance refers to a lending commitment provided by an investment bank that is advising a seller in an M&A setting. The key features are that whoever wins the bidding contest has the option (but not the obligation) to accept the loan offer; and the details of the loan are known in advance (loan size, interest rate, etc.) Arranging stapled finance has become common, and it is taken up by many private equity funds. This paper shows that it is not simply a method to speed up an M&A transaction, or to eliminate the risk of a deal falling through because the winning bidder cannot put together a financing package. We show that the option of accepting a preapproved loan affects the bidding, which becomes more competitive. The seller benefits, because stapled finance increases the expected price. However, the lender cannot expect to break even when offering stapled finance and must be compensated for offering the loan. Even after doing so, the net benefit of arranging stapled finance for the seller is strictly positive. We also show that the benefits of stapled finance accrue only if the pool of bidders includes financial buyers, for example LBO funds.

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JEL codes: *G24, G32, G34*

1 Introduction

Stapled Finance[1] is a loan commitment that is "stapled" onto an offering memorandum, by the investment bank advising the seller in an M&A transaction. It is available to whoever wins the bidding contest for the asset or firm that is being put up for sale; but the winner is under no obligation to accept the loan offer. Stapled finance is usually offered early in the bidding process, providing the potential buyers with an indication of how much they can borrow against the target's assets and cash flow if they win, and under what conditions (interest rate, maturity, covenants, etc.)

Practitioners have listed many benefits of arranging stapled finance, both for the seller and the potential buyers.[2] Amongst them are the possibility of attracting bidders; time savings because the bidders know what sort of financing is available; and a reduced risk of a closed transaction falling through because the winner could not line up the financing (at reasonable rates) that she required.[3] Additionally, terms of the loan may inform the bidders about the range in which they are expected to bid; and the bidders may infer information about the lender's value estimate from the stapled finance package, so a seller could use stapled finance to reveal and "certify" good news about the target's value.

In this paper we show that arranging stapled finance also affects the bidding itself, by making it more competitive. Consequently, an appropriately designed stapled finance package increases the expected price that will be paid to the seller. The key characteristic of stapled finance is that terms are fixed before the bidding starts, and the winner of the bidding contest can choose whether to accept the offer. In contrast, loans that bidders negotiate independently with third-party lenders (either before or after bidding starts) do not produce the same benefits for the seller. We also show that the benefits arise only if the bidder pool includes financial buyers, for example LBO funds. If the pool of bidders includes trade

[1] "Stapled Finance" is also referred to as "Stapled Financing," "Staple Financing," or "Staple Finance."

[2] For an overview, see Kevin Miller, "In Defense of Stapled Finance." *Boardroom Briefing*, Vol. 3(3), Fall 2006, pp. 44–49 (published by *Directors & Boards* magazine). Or see *The Vernimmen.com Newsletter*, No. 20, November 2006.

[3] Buyout funds often arrange their financing after a merger agreement is signed. For example, the financing for KKR's recent takeover of Toys "R" Us was uncertain for almost two months (see In re Toys "R" Us, Inc. Shareholder Litigation, Cons. C.A. 1212-N (Del. Ch. Jun. 24, 2005)).

buyers, only (and no financial buyers), then arranging stapled finance does not affect the bidding.[4]

We show that the investment bank providing the stapled finance expects *not* to break even; that is an unavoidable characteristic of stapled finance when it is designed optimally. Our results suggest that stapled finance that benefits the seller can be arranged if it is possible to compensate the investment bank for its expected loss, for example with an up-front fee, or by retaining it for other fee-based services. The fees that investment banks earn when providing high-yield financing packages may also form part of this sort of compensation.[5]

There is no systematic evidence on the supply of and demand for stapled finance in M&A transactions. Anecdotal evidence from the business press suggests that investment banks started including the possibility of offering stapled finance in their sales pitches to potential sellers in 2001.[6] Since then, stapled finance seems to have become the norm, rather than the exception.[7] Recent cases of deals in which stapled finance was arranged include the sales of Michaels Stores[8] (the US arts and crafts supplies chain), Bally Total Fitness Holding,[9] and Dunkin Brands[10] (owner of the Dunkin' Donuts brand, amongst others).

[4] Trade buyers are firms that plan to integrate the target into their existing operations if they win, for example competitors, suppliers, customers, etc.

[5] "Typical fees for advising on a corporate sale are about 0.5 percent of the transaction's value. The lead arranger of loans for a leveraged buyout can make 1.3 percent to 1.5 percent of a loan's value." ("'Stapled' Loans Create Potential Conflicts for Merger Advisers," *Bloomberg*, October 24, 2005.) See also "Booming LBO-Firm Business Is a Boon to Investment Banks," *Wall Street Journal*, August 18, 2004, pg. C.4.

[6] "Bally calls in Deutsche for staple," TheDeal.com, May 4, 2006.

[7] See "Staple financing gains following in M&A deals," *Corporate Financing Week (Institutional Investor)*, June 27, 2004. Similar statements can be found in other publications. ""Today, a deal without stapled financing is mostly the exception rather than the norm," said an executive with one Wall Street investment bank. It is particularly likely to be offered, he added, in deals where the seller is a leveraged buyout firm." ("Popular LBO staple financing raises eyebrows," *Dow Jones News Service*, January 10, 2005.) "Staple financing was offered by banks this year in about 90 percent of the auctions in Europe where buyout firms sold businesses to other buyout firms. [. . .] Staple financing is rapidly becoming standard practice due to the increasing importance of private equity as buyers of businesses." ("'Stapled' loans create potential conflicts for merger advisers," *Bloomberg*, October 24, 2005.) A survey of participants in the European private equity industry found that nearly one in two private equity funds had recently arranged stapled finance when putting up assets for sale. ("Private equity in 2006: The year of living dangerously," *Financial News*, February 2006.)

[8] See "JPMorgan helps Michaels Stores to fast and favourable results,", *Financial Times*, January 25, 2007.

[9] See "Bally calls in Deutsche for staple," *TheDeal.com*, May 4, 2006.

[10] See "Bidders show strong appetite for a taste of Dunkin Brands," *Financial Times*, October 10, 2005, pg. 25. This seller-advisory plus lending deal got more complicated when it emerged that JPMorgan would play a third role — that of a potential buyer; see "J.P. Morgan to wear many hats in auction," *Wall Street Journal*, December 8, 2005, pg. C4.

These reports also agree in their assessment of who uses stapled finance: It seems that it is taken on almost exclusively by private equity funds (LBO funds), while trade buyers tend to forgo the option. That is consistent with our results. The reports also seem to agree in the judgment that many of the offered finance packages are "aggressive", often including loan sizes that are above the bidders' (and observers') expectations.[11] Again, this is consistent with our results: It is an essential characteristic of optimally designed stapled finance that the lender's expected net payoff is negative, and often a large loan is optimal.

We analyze the role of stapled finance in a simple bidding model, with two potential buyers. One of these bidders is a trade buyer, who plans to integrate the target into its operations. The other bidder is a financial buyer (a private equity fund, say), who plans to own the target for a few years, maybe restructure it, and eventually sell it (maybe in parts) at a profit. The financial buyer does not plan to integrate the target into its other holdings; instead, the target is regarded as part of a financial portfolio, with a separate economic and legal identity. Importantly, this makes it possible to isolate financial problems (should they arise) in the target firm, without affecting the financial buyer's other assets.

We assume that both bidders have access to sufficient funds to purchase the target. In other words, we assume away liquidity needs as a driving force for the benefits of stapled finance. Besides allowing us to focus on the effects that stapled finance has on the bidding behavior, it is also a realistic assumption, since private equity funds tend to have more funds available than they can invest.[12] Furthermore, we show that if both financial and trade buyers can access competitive debt markets to finance their bids, this possibility does not

[11] "Most buyout executives contacted for this article agree that the staple financing typically represents the most generous deal available." ("Popular LBO staple financing raises eyebrows," *Dow Jones News Service*, January 10, 2005.) "According to a general partner of a private equity fund, "Banks are being pressured to come up with aggressive staple financing and sometimes it means they are not comfortable with the amount of debt they are putting forward. In one case recently, the bank actually told us it didn't want to lend the amount included in the staple package. Inevitably, that made us nervous." [...] Others agreed banks were sometimes being too aggressive in offering staple financing. David Silver at Robert W Baird said: "With the advent of staple financing and leverage multiples where they've been, we have seen some transactions where banks are willing to lend and private equity firms are put off because the staple finance package implies a valuation they're not comfortable with."" ("Private equity in 2006: The year of living dangerously," *Financial News*, February 2006.) See also "Bidders show strong appetite for a taste of Dunkin Brands," *Financial Times*, October 10, 2005, pg. 25.

[12] See, e.g., "Private equity's new challenge," *McKinsey on Finance*, Issue 12, Summer 2004 (reprinted in *The McKinsey Quarterly*, September 16, 2004).

affect the bidding behavior, and therefore the seller's expected price.

The financial buyer benefits from accepting stapled finance if it is designed appropriately. Financial buyers plan to keep the target as a separate legal entity, which makes it is possible to default on that debt without endangering other assets that the financial buyer owns. If the stapled finance deal seems advantageous to the financial buyer, given her value estimate (and therefore disadvantageous to the lender), then the debt will be accepted; if it does not seem attractive, the financial buyer will decline the offer (and maybe negotiate a loan independently, with a third-party lender). It is the optionality of stapled finance, paired with limited liability, that creates a benefit for the financial buyer. In contrast, trade buyers who plan to integrate the target into their other operations do not enjoy any downside protection, since the lender in the stapled finance package may force large parts of the trade buyer's business into bankruptcy if there is a default. Consequently, the stapled finance offered to the (as yet unknown) winner typically seems unattractive to trade buyers, who can negotiate a loan (if desired) at competitive terms with a third-party lender.

The bidding is affected because the financial buyer often knows whether she will accept the stapled finance if she wins; and since she accepts it only if it is to her advantage, that advantage should be reflected in her bid. This makes her a stronger competitor in her rival's eyes (the trade buyer), and this drives up the expected price that will be paid to the seller. Of course, this comes at the expense of the investment bank that commits to providing the stapled finance (again, because the loan will be accepted only if its terms are advantageous for the winner). Also, the strengthening of the financial buyer as a bidder implies that she will sometimes win even if her valuation is lower than that of her rival. In other words, the allocation becomes inefficient, and less value is therefore created by the sale. That is bad news for the seller, who is trying to extract as much value from the bidders as possible. However, as long as the stapled finance package is designed optimally, the net effect for the seller is always positive: Even after compensating the investment bank for her expected loss, the expected price is higher than if stapled finance was not offered.

We also analyze the case in which both bidders are financial buyers. Here, the effects are stronger, because *both* bidders' expected benefits of accepting stapled finance are reflected in their bids; while the financial buyer benefits from the availability of stapled finance when competing with a trade buyer, if the pool of bidders includes financial buyers, only, then these financial buyers would prefer (from an ex-ante perspective) if stapled finance was not available.

The role of debt in takeover settings has been analyzed before. For example, Jensen (1986) shows that highly levered transactions may be beneficial in the presence of agency problems; Clayton and Ravid (2002) show that increasing bidder leverage may reduce the degree of competition in an auction, if the leverage is sufficiently high; and Müller and Panunzi (2004) show that debt can be used to (partly) overcome the freerider problem in tender offers. Other papers study the role of financial leverage in the target, before it is put up for sale. Stulz (1988) shows that the management of a more highly levered target enjoys more voting power, enabling it to require a higher premium from potential bidders. Israel (1991) shows that target shareholders can benefit by levering the target if part of the value increase from a merger flows to the target debt holders.[13] Our analysis of debt is different since we consider debt that is arranged by the seller for the winning bidder, with terms that are approved before the bidding starts. As stated above, debt that is either on the target's or a bidder's balance sheet before the bidding starts, or that is taken on after the bidding contest is over, does not have the effects on the bidding on which we are focusing.

Similarly, auction models have been used before to analyze takeover contests. Our model is most closely related to Povel and Singh (2004, 2006, 2007), who analyze the role of informational asymmetries between bidders on optimal auction design, and the role of sale-backs in bankruptcy. Earlier contributions that analyze takeover contests as auctions include (amongst others) Fishman (1988); Bhattacharyya (1992); Daniel and Hirshleifer (1992); Burkart (1995); Singh (1998); Bulow et al. (1999); Ravid and Spiegel (1999), and Rhodes-Kropf and Viswanathan (2004).

Our results are related to a strand of the auction literature that analyzes bidding with securities: See Hansen (1985); Samuelson (1987); Crémer (1987); Riley (1988); Zheng (2001); Rhodes-Kropf and Viswanathan (2000, 2005); and DeMarzo et al. (2005). These contribu-

[13] Also see Israel (1992) and Harris and Raviv (1988).

tions show that a seller benefits from requiring the bidders to pay with securities (debt, equity, royalties, etc.) instead of cash. The intuition for this type of result is that when accepting a payment in shares, say, the seller participates in the value that the winning bidder realizes; and since higher-valuation bidders have a higher chance of winning, the seller's equity stake is more valuable than just taking cash. In other words, since the seller can directly link the expected value of a bid to the information that a bidder privately observes, the seller is able to extract more value from the bidders.[14] DeMarzo et al. (2005) show that the seller benefits more if the security's payoff is a steeper function of the target's value. For example, requiring equity bids is better than requiring debt or (even worse) cash bids. They further show that if the seller gives the bidders the freedom to bid with any security, then the bidders will choose debt or cash bids, the seller's least preferred types of security.

Our paper is related to this literature because in our model, the bidders may finance their bids using debt. However, in our model the seller accepts cash bids, only. That seems reasonable in many M&A situations, for example if a firm is selling off non-core divisions to enable it to focus on its main business: If the firm retained a financial stake in the division it put up for sale, there would remain a need to be involved in this division, reducing the firm's ability to focus on the other operations. Another distinction is that we consider asymmetric bidders in our model: In equilibrium, some bidders always decline the stapled finance they are being offered, while other bidders may accept or decline it.

The rest of the paper proceeds as follows. In Section 2, we present the model. In Section 3, we derive the equilibrium bidding strategies, given the details of the stapled finance offer. In Section 4, we show that there always exists a stapled finance package that benefits the seller. In Section 5, we describe some properties of the optimal stapled finance package. Section 6 concludes.

[14] Equity bids refer to shares in the target, not in the combined firm that arises if the winning bidder merges with the target (on that, see, e.g., Fishman (1989)).

2 The Model

A target firm is for sale, and two bidders, $i, j \in \{1, 2\}$, are interested in buying it. These bidders have independent and uncertain value estimates of the target. We assume that the bidders' full information values of the target firm are t_1 and t_2, independently and identically distributed on the support $\left[\underline{t}, \bar{t}\right]$, with density f and c.d.f. F. Denote the expected value of t_i by $E[t_i]$. We assume that f is continuous and differentiable on $\left[\underline{t}, \bar{t}\right]$, and strictly positive on $\left(\underline{t}, \bar{t}\right)$.

The bidders cannot observe the realizations of t_i. Instead, they (privately) observe signals s_i such that

$$s_i = \begin{cases} t_i & \text{with prob } \varphi \\ \tau_i & \text{with prob } 1 - \varphi, \end{cases}$$

where τ_1 and τ_2 are i.i.d. random variables that have the same distributions as t_1 and t_2. Thus, with probability φ the signal s_i is informative, and with probability $1 - \varphi$ it is pure noise. Since the signal is completely uninformative if $\varphi = 0$, we will assume in the following that $0 < \varphi \leq 1$. Given the signal s_i, the expected value of the target to bidder i is

$$\varphi s_i + (1 - \varphi)E[t_i].$$

The seller cannot observe the bidders' signals, and she plans to hold a sealed-bid second-price auction to raise the highest possible price.[15] We assume that both bidders have large internal funds, making it possible to fund any (realistic) bid internally. However, as we will show, bidders may nevertheless take on debt to finance the acquisition.

Our focus will be on debt that is offered before the bidding starts. For tractability, we consider debt contracts (L, D), where L is the size of the loan that the winner of the bidding contest can accept, and D is the repayment that is due when cash flows from the acquisition are realized. Without loss of generality, $D \leq \bar{t}$. We allow for the possibility that L is higher than the price that the winner has to pay, which may happen if the losing bidder's valuation was low (the losing bidder's valuation determines the price that the winner has to pay in a

[15] An ascending (open outcry) auction may seem more realistic, but it is strategically equivalent to a second-price sealed-bid auction, so the results would be unchanged.

second-price auction). As will become clear below, the key element of stapled finance is that its terms are specified in advance. So even if the lender caps the size of the loan at or below the price to be paid, the beneficial effects for the seller should remain (but the analysis is more complicated).

Importantly, we allow for the possibility that the lender may not break even when offering stapled finance. We assume that since this can be anticipated in equilibrium, the seller will offer to compensate the investment bank for providing the loan.

The timing is as follows: First, the seller asks an investment bank to precommit to a loan (L, D), available to the winner of the bidding contest, irrespective of their identity, bid, or valuation. Second, the bidders submit their sealed bids. Third, the bidder who submitted the highest bid is declared the winner (we assume that if the bids are tied, a coin flip determines the winner) and is asked to pay a price equal to the second-highest bid. Fourth, the winning bidder decides whether to accept the stapled finance offer. Finally, the winner realizes cash flows from the target (the random variable t_i) and makes payments to the investment bank if the stapled finance package was accepted.

We will focus mostly on a model where the two bidders have one distinctive characteristic: bidder 1 is a financial buyer, for example an LBO fund; while bidder 2 is a trade buyer, for example a competitor of the target, or an upstream or downstream firm. The key characteristic of a trade buyer is that she will integrate the target in her other operations if she wins, while a financial buyer regards the target merely as yet another portfolio firm, that will be held for a while, maybe restructured, and then sold on. Because the target will not be integrated, it can go bankrupt without directly affecting the other holdings of the financial buyer. In contrast, if the target is integrated in a trade buyers's operations, then these operations and assets will be affected if there is a default. In other words, a financial buyer enjoys more limited liability protection as the owner of the target, compared with a trade buyer.[16]

As a benchmark, consider the standard equilibrium if stapled finance is unavailable. It

[16] This is not a key assumption for what follows. In fact, the same results hold (even more strongly) in a model with symmetric bidders that both enjoy limited liability, as we show below. The assumption instead serves to add realism to the model, since many M&A transactions attract both trade and financial buyers.

is a dominant strategy for the bidders to bid their own valuations,

$$b^{noD}(s_i) = \varphi s_i + (1-\varphi)E[t_i].$$

The seller's expected price is then

$$\begin{aligned} R^{noD} = & \int_{\underline{t}}^{\bar{t}} \int_{\underline{t}}^{s_i} \left(\varphi s_j + (1-\varphi)E[t_j]\right) f(s_j) ds_j\, f(s_i) ds_i \\ & + \int_{\underline{t}}^{\bar{t}} \int_{s_i}^{\bar{t}} \left(\varphi s_i + (1-\varphi)E[t_i]\right) f(s_j) ds_j\, f(s_i) ds_i. \end{aligned} \tag{1}$$

If stapled finance is available, the bidding behavior changes, because stapled finance is accepted only if it is beneficial, so its availability increases the bidders' valuations and therefore their bids. We analyze these effects in what follows.

3 Equilibrium Bidding Strategies

Suppose the bidding is over, and a winner has been declared, who has to pay the loser's bid. Will this bidder accept the stapled finance offer (L, D)?

First, consider the trade buyer, bidder 2. Assuming that this is a large firm with sufficiently high cash flows, it will always be able to repay D. So for bidder 2, the stapled finance is attractive only if $L > D$.

Now consider the financial buyer, bidder 1. Since the target will not be integrated in its other operations, limited liability is an important concern if the debt is risky. Bidder 1 will accept the stapled finance if she expects that the lender will not break even. That is the case if $V(L, D, s_1) < 0$, where $V(L, D, s_1)$ is the lender's payoff as predicted by bidder 1,

$$V(L, D, s_1) \equiv \varphi \cdot \min\{s_1, D\} + (1-\varphi)\int_{\underline{t}}^{D} t_1 f(t_1) dt_1 + (1-\varphi)\int_{D}^{\bar{t}} D f(t_1) dt_1 - L. \tag{2}$$

The first term is the repayment if the bidder's signal s_1 was informative, i.e., if $s_1 = t_1$; the second and third term are the expected repayment if the signal was pure noise; and L is the amount raised by accepting the stapled finance package. Notice that the lender cannot observe $V(L, D, s_1)$, since she cannot observe bidder 1's signal s_1.

If a bidder anticipates that she will accept the stapled finance offer if she wins, then the benefit that she expects should be added to her expected valuation of winning the target. This in turn affects her bid: In a sealed-bid second-price auction, it is a dominant strategy to bid the expected value of the target. Bidder 1's valuation and bid then is

$$b^D(s_1) = \varphi s_1 + (1-\varphi)E[t_1] - \min\{0, V(L, D, s_1)\}.$$

Notice that if $V(L, D, s_1) \geq 0$, then $b^D(s_1) = b^{noD}(s_1) = \varphi s_i + (1-\varphi)E[t_i]$.

Lemma 1 *Without loss of generality, we can set $L \leq D$.*

Proof. It is sufficient to show that for any contract with $L > D$, there exists a contract with $L = D$ that produces the same payoff for the seller. If $L > D$, then both bidders will always accept the loan. For bidder 1,

$$b_1^{D<L}(s_1) = L + (1-\varphi)\int_D^{\bar{t}} (t_1 - D)\, f(t_1)dt_1 + \varphi \cdot \max\{s_1 - D, 0\}$$

Bidder 2 expects a net benefit of $(L - D)$ and therefore bids

$$b_2^{D<L}(s_2) = L - D + \varphi s_2 + (1-\varphi)E[t_2].$$

Now consider a change in L by ΔL, such that $L + \Delta L \geq D$. This changes the bids by ΔL for any signal realization, without changing the identity of the winner. The price is changed by ΔL, but the expected loss that the lender makes is also changed by ΔL. Given our assumption that the seller compensates the lender for any losses she expects when providing the stapled finance, the net effect is nil. ■

Hence, in what remains we can focus on bidder 1's decisions, since it is never strictly beneficial for the seller to induce bidder 2 also to accept stapled finance.

Since $V(\cdot)$ is weakly increasing in s_1, we can define a cut-off signal $\widehat{s}$ such that bidder 1 accepts the stapled finance if s_1 is below $\widehat{s}$:

$$\widehat{s} = \begin{cases} \bar{t} & \text{if} \quad V(L, D, \bar{t}) < 0 \\ \min_{s \in [\underline{t}, \bar{t}]} \{ \ s \mid V(L, D, s) = 0 \ \} & \text{if} \quad V(L, D, \underline{t}) \leq 0 \leq V(L, D, \bar{t}) \\ \underline{t} & \text{if} \quad V(L, D, \underline{t}) > 0 \end{cases}$$

This cut-off $\widehat{s}$ divides the set of signals $\left[\underline{t}, \bar{t}\right]$ into (up to) three intervals: either $\underline{t} \leq \widehat{s} \leq D \leq \bar{t}$, or $\underline{t} \leq D \leq \widehat{s} = \bar{t}$. Notice that if $V(L, D, s_i) < 0$ for some $s_i \geq D$, then the same holds for all $s_i \geq D$.

Setting $V(L, D, \underline{t}) > 0$ is equivalent to not offering stapled finance at all, since the winning bidder would never accept the loan. So we can ignore this case in what follows. If the seller arranges stapled finance such that $\widehat{s} > \underline{t}$, then bidder 1's bid is increased for low signal realizations. This implies that bidder 2's chances of winning are reduced, but if bidder 2 wins, her price will tend to be higher.

Proposition 1 *If the seller arranges stapled finance such that $\underline{t} < \widehat{s}$, then this increases the expected price that trade buyers expect to pay contingent on winning.*

Proof. Bidder 1's bid increases for all $s_1 < \widehat{s}$, compared with a situation without any stapled finance. That reduces bidder 2's likelihood of winning with a low signal realization and therefore a low price. It also has a non-negative impact on the price that bidder 2 must pay with higher signal realizations. Thus, conditional on winning, bidder 2's expected price must increase. ■

This result implies that trade buyers should worry about competing bids from financial buyers for two reasons: Besides the obvious issue of increased competition, financial buyers may plan to accept the stapled finance package, which further strengthens the competition for the target. The result also implies that when studying empirical evidence on M&A transactions, it should not be surprising if trade buyers pay more when competing with financial buyers: This is not necessarily evidence of agency problems or poor governance (leading to overbidding by the trade buyers), as suggested by Bargeron et al. (2007), but it may instead be evidence of the seller's sophistication in marketing the target to a wide pool of bidders, making use of stapled finance to increase competition.

Proposition 1 suggests why the seller benefits from arranging stapled finance. Since $V(L,D,s_1) < 0$ if $s_1 < \widehat{s}$, bidder 1's bid is increased for low signals, compared with the setup in which stapled finance is not being offered. If bidder 2 wins with a high valuation while bidder 1's valuation is low, then bidder 2 will have to pay a higher price than without staple finance. However, there are two offsetting costs: First, bidder 1 bids more than her true valuation, and for some signal realizations, bidder 1 will win even though bidder 2 has a higher expected valuation. This introduces inefficiencies in the allocation, which reduces the value that is created by selling the target, value that the seller is trying to extract from the bidders. Second, bidder 1 accepts stapled finance that is provided at advantageous terms with positive probability; this comes at the lender's expense, who must in turn be compensated by the seller. We analyze the net effects of arranging stapled finance in the next section.

4 The Optimality of Arranging Stapled Finance

We now show that it is always possible to put together a stapled finance package that is strictly beneficial for the seller, despite the two drawbacks described in the last section (the expected value destruction if the winner does not have the highest valuation; and the need to compensate the lender for her expected loss). We first show that it is optimal to set $V(L,D,\bar{t}) \geq 0$, i.e., to offer stapled finance that the financial buyers will reject if their valuation is sufficiently high. Then we show that it is optimal to offer stapled finance that the financial buyers will accept if their valuation is sufficiently low, i.e., $V(L,D,\underline{t}) < 0$.

Lemma 2 *It is optimal for the seller to set $V(L,D,\bar{t}) \geq 0$.*

Proof. Suppose $V_0 := V(L,D,\bar{t}) < 0$. If $s_1 \leq D$, then

$$\begin{aligned} b^D_{V_0}(s_1 \leq D) &= \varphi s_1 + (1-\varphi)E[t_1] - V(L,D,s_1) \\ &= \varphi D + (1-\varphi)E[t_1] - V(L,D,D) \\ &= \varphi D + (1-\varphi)E[t_1] - V_0, \end{aligned}$$

and bidder 1 wins if $\varphi D + (1-\varphi)E[t_1] - V_0 > \varphi s_2 + (1-\varphi)E[t_2] \iff D - \frac{V_0}{\varphi} > s_2$. We must have $D - \frac{V_0}{\varphi} < \bar{t}$, since otherwise bidder 1 always wins, and that would be dominated by not offering stapled finance at all. (The seller's expected price would be $E[t_i]$, which is less than what she expects from an auction without the stapled finance; on top of that, the seller would have to compensate the lender.) If $s_1 > D$, then $V(L, D, s_1) = V_0$,

$$b_{V_0}^D(s_1 > D) = \varphi s_1 + (1-\varphi)E[t_1] - V_0,$$

and bidder 1 wins if $\varphi s_1 + (1-\varphi)E[t_1] - V_0 > \varphi s_2 + (1-\varphi)E[t] \iff s_1 - \frac{V_0}{\varphi} > s_2$.

The seller's expected price is

$$\begin{aligned} R_{V_0}^D = &\int_{\underline{t}}^{D} \int_{\underline{t}}^{D-\frac{V_0}{\varphi}} \big(\varphi s_2 + (1-\varphi)E[t]\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\ &+ \int_{\underline{t}}^{D} \int_{D-\frac{V_0}{\varphi}}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t] - V(L,D,s_1)\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\ &+ \int_{D}^{\bar{t}+\frac{V_0}{\varphi}} \int_{\underline{t}}^{s_1-\frac{V_0}{\varphi}} \big(\varphi s_2 + (1-\varphi)E[t]\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\ &+ \int_{D}^{\bar{t}+\frac{V_0}{\varphi}} \int_{s_1-\frac{V_0}{\varphi}}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t] - V_0\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\ &+ \int_{\bar{t}+\frac{V_0}{\varphi}}^{\bar{t}} \int_{\underline{t}}^{\bar{t}} \big(\varphi s_2 + (1-\varphi)E[t]\big)\, f(s_2)ds_2\, f(s_1)ds_1. \end{aligned}$$

The lender's expected loss, which requires compensation from the seller, is

$$\begin{aligned} \mathcal{V}_{V_0}^D = &\int_{\underline{t}}^{D} \int_{\underline{t}}^{D-\frac{V_0}{\varphi}} V(L,D,s_1) f(s_2)ds_2\, f(s_1)ds_1 + \int_{D}^{\bar{t}+\frac{V_0}{\varphi}} \int_{\underline{t}}^{s_1-\frac{V_0}{\varphi}} V_0 f(s_2)ds_2\, f(s_1)ds_1 \\ &+ \int_{\bar{t}+\frac{V_0}{\varphi}}^{\bar{t}} \int_{\underline{t}}^{\bar{t}} V_0 f(s_2)ds_2\, f(s_1)ds_1. \end{aligned}$$

We now show that the seller benefits from decreasing L, by showing that $\frac{\partial}{\partial L}\left(R_{V_0}^D + \mathcal{V}_{V_0}^D\right)$ is negative. Add $R_{V_0}^D$ and $\mathcal{V}_{V_0}^D$, substitute $V(L, D, s_1) = V_0 + \varphi\,(s_1 - D)$ if $s_1 \leq D$, take the derivative, substitute $\frac{\partial V_0}{\partial L} = -1$, and rearrange, to obtain

$$
\begin{aligned}
&\frac{\partial}{\partial L}\left(R^D_{V_0} + \mathcal{V}^D_{V_0}\right) \\
&= \int_{\underline{t}}^{D} \big(\varphi\,(s_1 - D) + V_0\big)\, f(D - \tfrac{V_0}{\varphi})\frac{1}{\varphi} f(s_1) ds_1 + \int_{D}^{\bar{t}+\frac{V_0}{\varphi}} V_0 f(s_1 - \tfrac{V_0}{\varphi})\frac{1}{\varphi} f(s_1) ds_1 \\
&\quad - \int_{\underline{t}}^{D}\int_{\underline{t}}^{D-\frac{V_0}{\varphi}} f(s_2)ds_2\, f(s_1)ds_1 + \int_{\underline{t}}^{D}\int_{D-\frac{V_0}{\varphi}}^{\bar{t}} f(s_2)ds_2\, f(s_1)ds_1 \\
&\quad - \int_{D}^{\bar{t}+\frac{V_0}{\varphi}}\int_{\underline{t}}^{s_1-\frac{V_0}{\varphi}} f(s_2)ds_2\, f(s_1)ds_1 + \int_{D}^{\bar{t}+\frac{V_0}{\varphi}}\int_{s_1-\frac{V_0}{\varphi}}^{\bar{t}} f(s_2)ds_2\, f(s_1)ds_1 \\
&\quad - \int_{\bar{t}+\frac{V_0}{\varphi}}^{\bar{t}}\int_{\underline{t}}^{\bar{t}} f(s_2)ds_2\, f(s_1)ds_1
\end{aligned}
$$

The first two integrals are negative. And since $V_0 < 0$, the sum of the remaining five integrals is also negative. ■

Lemma 2 suggests that the stapled finance offer should not be too generous, i.e., not so generous that the financial buyers always take it up. That allows us to focus on the case $V(L, D, \bar{t}) \geq 0$ in what follows.

Proposition 2 *There always exists a stapled finance package that is beneficial for the seller.*

Proof. For any $\widehat{s} \in (\underline{t}, \bar{t}]$, the seller/lender can find (L, D) such that $\widehat{s} \leq D \leq \bar{t}$ and $V(L, D, \widehat{s}) = 0$. The seller's expected price with (L, D) is

$$
\begin{aligned}
R^D_{\widehat{s}} = &\int_{\underline{t}}^{\widehat{s}}\int_{\underline{t}}^{\widehat{s}} \big(\varphi s_2 + (1-\varphi)E[t_2]\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\
&+ \int_{\underline{t}}^{\widehat{s}}\int_{\widehat{s}}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t_1] - V(L, D, s_1)\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\
&+ \int_{\widehat{s}}^{\bar{t}}\int_{\underline{t}}^{s_1} \big(\varphi s_2 + (1-\varphi)E[t_2]\big)\, f(s_2)ds_2\, f(s_1)ds_1 \\
&+ \int_{\widehat{s}}^{\bar{t}}\int_{s_1}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t_1]\big)\, f(s_2)ds_2\, f(s_1)ds_1.
\end{aligned}
$$

The lender's expected loss, which requires compensation from the seller, is

$$\mathcal{V}_{\widehat{s}}^{D}=\int_{\underline{t}}^{\widehat{s}}\int_{\underline{t}}^{\widehat{s}}V(L,D,s_1)f(s_2)ds_2\,f(s_1)ds_1.$$

Add $R_{\widehat{s}}^{D}$ and $\mathcal{V}_{\widehat{s}}^{D}$, and subtract the expected price in the absence of stapled finance, R^{noD} (from Eqn. (1)), to obtain the net benefit from arranging stapled finance. Rearrange to obtain

$$\begin{aligned}
&R_{\widehat{s}}^{D}+\mathcal{V}_{\widehat{s}}^{D}-R^{noD}\\
&=\int_{\underline{t}}^{\widehat{s}}\int_{s_1}^{\widehat{s}}\varphi(s_2-s_1)f(s_2)ds_2\,f(s_1)ds_1\\
&\quad-\int_{\underline{t}}^{\widehat{s}}\int_{\widehat{s}}^{\overline{t}}V(L,D,s_1)f(s_2)ds_2\,f(s_1)ds_1+\int_{\underline{t}}^{\widehat{s}}\int_{\underline{t}}^{\widehat{s}}V(L,D,s_1)f(s_2)ds_2\,f(s_1)ds_1\\
&=\int_{\underline{t}}^{\widehat{s}}\int_{s_1}^{\widehat{s}}\varphi(s_2-s_1)f(s_2)ds_2\,f(s_1)ds_1-\big(1-2F(\widehat{s})\big)\int_{\underline{t}}^{\widehat{s}}V(L,D,s)f(s)ds
\end{aligned}$$

Substitute $V(L,D,s_1)=V(L,D,s_1)-V(L,D,\widehat{s})=\varphi\left(s_1-\widehat{s}\right)$ in the second integrand, and rearrange to obtain

$$R_{\widehat{s}}^{D}+\mathcal{V}_{\widehat{s}}^{D}-R^{noD}=\int_{\underline{t}}^{\widehat{s}}\int_{s_1}^{\widehat{s}}\varphi(s_2-s_1)f(s_2)ds_2\,f(s_1)ds_1+\big(1-2F(\widehat{s})\big)\int_{\underline{t}}^{\widehat{s}}\varphi\left(\widehat{s}-s\right)f(s)ds. \quad (3)$$

The first integral is strictly positive if $\widehat{s}>\underline{t}$ and $\varphi>0$. The second integral is positive if $0<F(\widehat{s})<\frac{1}{2}$, which is a sufficient (but not necessary) condition for the entire term to be positive. ■

Why is it always beneficial for the seller to arrange some stapled finance? The benefit comes from the increase in bidder 1's bid when s_1 is low. Because of the nature of the debt repayment schedule, this bid increase is always strongest for the lowest signals s_1. Therefore, the lower s_1, the larger the increase in the price that bidder 2 must pay if she wins. For signal realizations such that bidder 2 wins, the seller gets the benefit at no cost: Bidder 2 never accepts the stapled finance. The cost arises if bidder 1 wins with a low signal. If $s_1<\widehat{s}$, she will accept the stapled finance, so the lender requires a compensation from the seller. However, if $s_1 < \widehat{s}$, then it may happen that even if bidder 1's bid was higher than bidder 2's, her signal was not. In other words, bidder 1 will overpay. This reduces bidder 1's net benefit of having access to stapled finance, but not completely, as we show next.

Proposition 3 *If stapled finance is arranged such that $\underline{t} < \widehat{s} < \bar{t}$, then bidder 1 strictly benefits from the availability of stapled finance if $s_1 \in (\underline{t}, \widehat{s})$, while bidder 2 is strictly worse off.*

Proof. Recall that if $s_1 < \widehat{s}$ and $s_2 < \widehat{s}$, then bidder 1's bid $b^D(s_1)$ is higher than bidder 2's. Bidder 1's expected net payoff from bidding $b^D(s_1)$ is

$$\int_{\underline{t}}^{\widehat{s}} \big(\varphi\left(s_1 - s_2\right) - V(L, D, s_1)\big) f(s_2) ds_2.$$

If stapled finance was not available, bidder 1 would bid $b^{noD}(s_1)$ and expect a net payoff

$$\int_{\underline{t}}^{s_1} \varphi\left(s_1 - s_2\right) f(s_2) ds_2$$

Bidder 1 benefits from the availability of stapled finance, given a signal realization $s_1 \in (\underline{t}, \widehat{s})$, if

$$\begin{aligned}
\int_{\underline{t}}^{\widehat{s}} \left(\varphi\left(s_1 - s_2\right) - V(L, D, s_1)\right) f(s_2) ds_2 &> \int_{\underline{t}}^{s_1} \varphi\left(s_1 - s_2\right) f(s_2) ds_2 \\
-\int_{\underline{t}}^{\widehat{s}} V(L, D, s_1) f(s_2) ds_2 &> \int_{s_1}^{\widehat{s}} \varphi\left(s_2 - s_1\right) f(s_2) ds_2 \\
-\int_{\underline{t}}^{s_1} V(L, D, s_1) f(s_2) ds_2 &> \int_{s_1}^{\widehat{s}} \big(\varphi\left(s_2 - s_1\right) + V(L, D, s_1)\big) f(s_2) ds_2 \\
-\int_{\underline{t}}^{s_1} V(L, D, s_1) f(s_2) ds_2 &> \int_{s_1}^{\widehat{s}} V(L, D, s_2) f(s_2) ds_2.
\end{aligned}$$

That is always satisfied if $\underline{t} < s_1 < \widehat{s}$. Bidder 2 is worse off with any signal: She loses her entire expected benefit if $s_2 < \widehat{s}$; and if $s_2 > \widehat{s}$, the expected net payoff is

$$\int_{\underline{t}}^{\widehat{s}} \varphi\left(s_2 - \widehat{s}\right) f(s_1) ds_1 + \int_{\widehat{s}}^{s_2} \varphi\left(s_2 - s_1\right) f(s_1) ds_1 < \int_{\underline{t}}^{s_2} \varphi\left(s_2 - s_1\right) f(s_1) ds_1$$

(the right-hand side is her expected payoff in the absence of stapled finance). ■

In other words, even if bidder 1 ends up overpaying with some signal realizations, this does not completely offset her benefit from accepting the stapled finance. If the stapled finance is designed optimally, then this increase in bidder 1's expected net payoff is more than offset by the expected price increase for bidder 2, if she wins, since we can always find a contract (L, D) that benefits the seller.

These changes in the expected net payoffs are not zero-sum transfers: If $s_1 < \widehat{s}$ and $s_2 < \widehat{s}$, then bidder 1 always wins, so with probability 1/2 bidder 1 wins even though she has a lower valuation than bidder 2. In other words, arranging stapled finance biases the allocation and therefore leads to efficiency losses. As we argued above, less value is then created with the sale, which reduces the value that the seller can hope to extract from the bidders. Importantly, the seller can never achieve full "rent extraction": She cannot hope to get the bidders to always reveal and pay their highest willingness to pay.

Nevertheless, it is interesting that the seller always benefits from arranging stapled finance. That seems intuitive if one compares the likelihood of having to offer the advantageous stapled finance to bidder 1 with the likelihood of an increased price from bidder 2. Given $s_1 < \widehat{s}$ (which is necessary for stapled finance to affect the bid), the amount of the price increase if bidder 2 wins is the same as the benefit bidder 1 gets if she wins and accepts the stapled finance (both are equal to $-V(L, D, s_1)$). Since bidder 1 wins if $s_2 < \widehat{s}$, the probability of the price increase is $(1 - F(\widehat{s}))$; and the probability of having to provide the stapled finance is $F(\widehat{s})$. So as long as $\widehat{s}$ is not too large, the expected benefit is larger than the expected cost. (This explains the result discussed in the proof of Proposition 2, that any stapled finance package that satisfies $F(\widehat{s}) \leq \frac{1}{2}$ benefits the seller.)

Our result that arranging stapled finance is beneficial for the seller can also be understood when considering the results in the literature on bidding with securities. Hansen (1985); Samuelson (1987); Crémer (1987); Riley (1988); Zheng (2001); Rhodes-Kropf and Viswanathan (2000, 2005); and DeMarzo et al. (2005) show that if the bidder's valuation is observable after the auction, then the seller benefits if she links the price that the winner has to pay to the realized valuation. One possibility is to have bidders compete by offering royalties, i.e., a share in the realized cash flows. That would not be useful if the seller wants to dispose of the firm and its risky cash flows because of immediate liquidity needs, or because of a wish to focus the other operations of the firm. Other suggested methods to link realized valuations and prices require bids in the form of standard securities, for example equity stakes in the target, or loans supported by the target's assets and cash flows. Again, if the seller's aim is to dispose of the target, that is not useful.

Stapled finance helps, because the seller gets a cash payment from the winner in exchange for the target, yet she can link the price with the realized value. This is done by letting low-valuation financial bidders pay with cash and with a debt stake, but this debt stake is held by an investment bank instead of the seller. As DeMarzo et al. (2005) show, having the bidder offer an equity stake would be even better for the seller. However, in practice, bidders seem to prefer debt finance, and stapled finance is therefore usually provided in the form of debt finance (albeit with varying degrees of risk), hence we focus on debt finance.[17] Also, DeMarzo et al. (2005) show that if the bidders have the choice of either debt or equity bids, they would prefer debt bids. Finally, there may be contractual reasons for the use of debt in buyouts; for example, using debt is optimal if the cash flows that the winning bidder realizes with the target are unobservable (see Povel and Raith (2004)).

As we have shown, the seller benefits from arranging stapled finance, and so does bidder 1, the financial buyer who may accept the offer. In contrast, the trade buyer suffers. This suggests that we should analyze the seller's problem if she faces two financial buyers, and no trade buyers.

Proposition 4 *If the bidders include financial buyers, only, then there always exists a stapled finance package that is beneficial for the seller.*

Proof. The case with two financial buyers is easier to analyze, since the bidders are symmetric. Assume that the seller chooses (L, D) such that $V(L, D, \underline{t}) \leq 0 \leq V(L, D, \bar{t})$. The bidding strategies are the same as defined above: Bidder i bids $\varphi s_i + (1-\varphi)E[t_i] - V(L, D, s_i)$ if $s_i < \widehat{s}$, and $\varphi s_i + (1-\varphi)E[t_i]$ otherwise. We have assumed that if the bids are tied (which

[17] Recently, however, investment banks have been willing to buy "bridge equity" in LBOs. See, e.g., "Banks on a Bridge Too Far?" *Wall Street Journal*, June 28, 2007, pg. C.1.

happens if $s_1, s_2 < \widehat{s}$), a coin is flipped to determine the winner. The seller's expected price is then

$$\begin{aligned}
R^{D2}_{\widehat{s}} = & \int_{\underline{t}}^{\widehat{s}} \int_{\underline{t}}^{\widehat{s}} \frac{1}{2} \left(\varphi s_2 + (1-\varphi)E[t_2] - V(L,D,s_2)\right) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\underline{t}}^{\widehat{s}} \int_{\underline{t}}^{\widehat{s}} \frac{1}{2} \left(\varphi s_1 + (1-\varphi)E[t_1] - V(L,D,s_1)\right) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\underline{t}}^{\widehat{s}} \int_{\widehat{s}}^{\bar{t}} \left(\varphi s_1 + (1-\varphi)E[t_1] - V(L,D,s_1)\right) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\widehat{s}}^{\bar{t}} \int_{\underline{t}}^{\widehat{s}} \left(\varphi s_2 + (1-\varphi)E[t_2] - V(L,D,s_2)\right) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\widehat{s}}^{\bar{t}} \int_{\widehat{s}}^{s_1} \left(\varphi s_2 + (1-\varphi)E[t_2]\right) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\widehat{s}}^{\bar{t}} \int_{s_1}^{\bar{t}} \left(\varphi s_1 + (1-\varphi)E[t_1]\right) f(s_2) ds_2 \, f(s_1) ds_1 .
\end{aligned}$$

The lender's expected loss, which requires compensation from the seller, is

$$\mathcal{V}^{D2}_{\widehat{s}} = \int_{\underline{t}}^{\widehat{s}} \int_{\underline{t}}^{\widehat{s}} \left(\frac{1}{2} V(L,D,s_1) + \frac{1}{2} V(L,D,s_2)\right) f(s_2) ds_2 \, f(s_1) ds_1 .$$

Add $R^{D2}_{\widehat{s}}$ and $\mathcal{V}^{D2}_{\widehat{s}}$, and subtract R^{noD} (from Eqn. (1)) to obtain the net benefit from arranging stapled finance. Substitute $V(L,D,s_i) = V(L,D,s_i) - V(L,D,\widehat{s}) = \varphi s_i - \varphi \widehat{s}$ (if $s_i < \widehat{s}$), and rearrange, to obtain

$$\begin{aligned}
& R^{D2}_{\widehat{s}} + \mathcal{V}^{D2}_{\widehat{s}} - R^{noD} \\
& = \int_{\underline{t}}^{\widehat{s}} \int_{\underline{t}}^{s_1} \frac{1}{2} \varphi \left(s_1 - s_2\right) f(s_2) ds_2 \, f(s_1) ds_1 + \int_{\underline{t}}^{\widehat{s}} \int_{s_1}^{\widehat{s}} \frac{1}{2} \varphi \left(s_2 - s_1\right) f(s_2) ds_2 \, f(s_1) ds_1 \\
& \quad - \int_{\underline{t}}^{\widehat{s}} \int_{\widehat{s}}^{\bar{t}} \varphi \left(s_1 - \widehat{s}\right) f(s_2) ds_2 \, f(s_1) ds_1 - \int_{\widehat{s}}^{\bar{t}} \int_{\underline{t}}^{\widehat{s}} \varphi \left(s_2 - \widehat{s}\right) f(s_2) ds_2 \, f(s_1) ds_1
\end{aligned}$$

The first two integrals are equal, so we obtain

$$R^{D2}_{\widehat{s}} + \mathcal{V}^{D2}_{\widehat{s}} - R^{noD} = \varphi \int_{\underline{t}}^{\widehat{s}} \int_{\underline{t}}^{s_1} \left(s_1 - s_2\right) f(s_2) ds_2 f(s_1) ds_1 + 2\varphi \left(1 - F(\widehat{s})\right) \int_{\underline{t}}^{\widehat{s}} \left(\widehat{s} - s\right) f(s) ds. \tag{4}$$

Since $\varphi > 0$, this term is strictly positive if $\widehat{s} > \underline{t}$. ■

If all bidders are financial buyers, stapled finance is beneficial for the seller because both bidders compete more aggressively if their valuations are low. We can now analyze whether this stronger competition always benefits the seller, compared with the situation in which there is one financial buyer and one trade buyer. For this, we need to compare the seller's expected price, net of the compensation for the lender, depending on the composition of the pool of bidders. We do so in two steps. First, we show that it is optimal to set $V(L, D, \bar{t}) \geq 0$, i.e., that the seller should arrange stapled finance such that it is declined by the financial buyer if her valuation is high enough. Then we show that the seller benefits more from arranging stapled finance if she is facing financial bidders, only.

Lemma 3 *If there are only financial buyers in the pool of bidders, it is weakly optimal to set* $V(L, D, \bar{t}) \geq 0$.

Proof. Suppose $V_0 := V(L, D, \bar{t}) < 0$. The seller's expected price, net of the compensation for the lender, is

$$\begin{aligned}
R_{V_0}^{D2} + \mathcal{V}_{V_0}^{D2} = & \int_{\underline{t}}^{D} \int_{\underline{t}}^{D} \frac{1}{2} \big(\varphi s_2 + (1-\varphi)E[t_2] - V(L, D, s_2) + V(L, D, s_1)\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\underline{t}}^{D} \int_{\underline{t}}^{D} \frac{1}{2} \big(\varphi s_1 + (1-\varphi)E[t_1] - V(L, D, s_1) + V(L, D, s_2)\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\underline{t}}^{D} \int_{D}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t_1] - V(L, D, s_1) + V_0\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{D}^{\bar{t}} \int_{\underline{t}}^{D} \big(\varphi s_2 + (1-\varphi)E[t_2] - V(L, D, s_2) + V_0\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{D}^{\bar{t}} \int_{D}^{s_1} \big(\varphi s_2 + (1-\varphi)E[t_2] - V_0 + V_0\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{D}^{\bar{t}} \int_{s_1}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t_1] - V_0 + V_0\big) f(s_2) ds_2 \, f(s_1) ds_1
\end{aligned}$$

Substitute $V(L, D, s_i) = V_0 + \varphi(s_i - D)$ if $s_i \leq D$, to obtain

$$\begin{aligned}
R_{V_0}^{D2} + \mathcal{V}_{V_0}^{D2} = & \int_{\underline{t}}^{D} \int_{\underline{t}}^{D} \frac{1}{2} \big(\varphi s_1 + (1-\varphi)E[t_2]\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\underline{t}}^{D} \int_{\underline{t}}^{D} \frac{1}{2} \big(\varphi s_2 + (1-\varphi)E[t_1]\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{\underline{t}}^{D} \int_{D}^{\bar{t}} \big(\varphi D + (1-\varphi)E[t_1]\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{D}^{\bar{t}} \int_{\underline{t}}^{D} \big(\varphi D + (1-\varphi)E[t_2]\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{D}^{\bar{t}} \int_{D}^{s_1} \big(\varphi s_2 + (1-\varphi)E[t_2]\big) f(s_2) ds_2 \, f(s_1) ds_1 \\
& + \int_{D}^{\bar{t}} \int_{s_1}^{\bar{t}} \big(\varphi s_1 + (1-\varphi)E[t_1]\big) f(s_2) ds_2 \, f(s_1) ds_1
\end{aligned}$$

So $R_{V_0}^{D2} + \mathcal{V}_{V_0}^{D2}$ does not depend on L, and it is therefore weakly optimal to set $V_0 = 0$. ■

The intuition for this result is the same as for Lemma 1 (that setting $L > D$ is not beneficial for the seller) and Lemma 2 (that setting $V(L, D, \bar{t}) < 0$ is sub-optimal if there are both financial and trade buyers). The stapled finance package should be generous enough, such that the financial buyer will accept it if her valuation is low enough. However, as it becomes more generous and the cut-off $\widehat{s}$ increases, the benefits decrease, since the compensation that must be paid to the lender increases for all signal realizations below $\widehat{s}$.

We can now show that stapled finance is more effective if there are only financial buyers in the pool of bidders.

Proposition 5 *The seller's expected net price (net of lender compensation) is higher if she is facing financial buyers, only, instead of both trade and financial buyers. It is lowest (equal to the expected price if there is no stapled finance) if the seller is facing trade buyers, only.*

Proof. We can show that $\left(R_{\widehat{s}}^{D2}+\mathcal{V}_{\widehat{s}}^{D2}\right)>\left(R_{\widehat{s}}^{D}+\mathcal{V}_{\widehat{s}}^{D}\right)$ holds for any $\widehat{s}\in\left(\underline{t},\overline{t}\right)$. Using Eqns. (3) and (4), we can rewrite $\left(R_{\widehat{s}}^{D2}+\mathcal{V}_{\widehat{s}}^{D2}\right)-\left(R_{\widehat{s}}^{D}+\mathcal{V}_{\widehat{s}}^{D}\right)$ as

$$
\begin{aligned}
&(R_{\widehat{s}}^{D2}+\mathcal{V}_{\widehat{s}}^{D2}-R^{noD})-\left(R_{\widehat{s}}^{D}+\mathcal{V}_{\widehat{s}}^{D}-R^{noD}\right)\\
&=\varphi\int_{\underline{t}}^{\widehat{s}}\int_{\underline{t}}^{s_1}(s_1-s_2)\,f(s_2)ds_2f(s_1)ds_1+2\varphi\,(1-F(\widehat{s}))\int_{\underline{t}}^{\widehat{s}}(\widehat{s}-s)\,f(s)ds\\
&\quad-\varphi\int_{\underline{t}}^{\widehat{s}}\int_{s_1}^{\widehat{s}}(s_2-s_1)\,f(s_2)ds_2f(s_1)ds_1-\varphi\left(1-2F(\widehat{s})\right)\int_{\underline{t}}^{\widehat{s}}(\widehat{s}-s)\,f(s)ds\\
&=\varphi\int_{\underline{t}}^{\widehat{s}}\left(\int_{\underline{t}}^{s_1}(s_1-s_2)\,f(s_2)ds_2-\int_{s_1}^{\widehat{s}}(s_2-s_1)\,f(s_2)ds_2\right)f(s_1)ds_1+\varphi\int_{\underline{t}}^{\widehat{s}}(\widehat{s}-s)\,f(s)ds
\end{aligned}
$$

The first integral equals zero, so for any $\widehat{s}>\underline{t}$ we have $\left(R_{\widehat{s}}^{D2}+\mathcal{V}_{\widehat{s}}^{D2}\right)>\left(R_{\widehat{s}}^{D}+\mathcal{V}_{\widehat{s}}^{D}\right)$.

The result that the expected net price is even lower with trade buyers, only, follows from the result that trade buyers do not accept the stapled finance (so their bidding is unaffected by its availability) and Propositions 2 and 4. That also implies that the expected price is equal to the expected price if there is no stapled finance. ■

The beneficial effects of stapled finance are thus amplified if the bidders are both financial buyers. In the case of one trade buyer and one financial buyer, the seller benefits because the stapled finance increases the trade buyer's expected price. But the financial buyer benefits, too, because depending on her valuation of the target, the stapled finance terms may be very attractive. That is not the case if the bidder pool consists of financial buyers, only. In that case, both bidders become more aggressive, and while the stapled finance terms may be attractive with low valuations, the expected benefit from being able to accept the stapled finance are outweighed by the expected increase in the price that the winner has to pay. The financial buyers find themselves in a situation that resembles a prisoner's dilemma: They would prefer stapled finance not to be available, but once it is available, it is a dominant strategy (with signal realizations $s_i<\widehat{s}$) to accept it. Notice that the winner of the bidding contest is not forced to accept the offer, since (by assumption) the bidders are not liquidity constrained. Instead, the bidders merely have the *option* to take advantage of the lender's offer, but the stapled finance package allows the seller to turn the financial buyers' opportunism against themselves.

To conclude this section, we show that if the bidders plan to arrange debt finance individually, either before submitting their bid (as a loan commitment) or after the bidding has ended, then the bidding is unaffected by those financing decisions. Suppose that stapled finance is not being arranged, and that for unmodeled reasons, the financial buyer plans to take on as much debt as possible if she wins (tax savings may be a reason; or the financial buyer may plan to use debt as a device to discipline the target's management). We assume that the lending market is competitive, so debt financing will be provided as long as the third-party lender expects to break even in equilibrium. To simplify things, we assume that lenders offer debt contracts (L, D) after observing a planned or winning bid.[18]

Proposition 6 *Suppose stapled finance is not available, but the bidders can raise debt financing in a competitive lending market. The availability of such third-party debt financing has no impact on the bidding strategies.*

The proof of this result can be found in the Appendix. The intuition is as follows. When making their competitive loan offers, the lenders expect to break even, given the bid (and therefore signal) that was observed. That must be true for any possible signal realization. Hence, if the loan contracts always let the lenders break even in equilibrium, the winning bidder cannot gain any advantage from accepting a loan. Therefore, the debt availability cannot affect her optimal bid.

The distinguishing feature of debt that is negotiated independently is that the third-party lender expects to break even. This confirms that a key characteristic of optimally designed stapled finance is that the financial buyers will often find its terms advantageous (i.e., disadvantageous for the lender). Without the loosened break-even condition for the lender (made possible by the seller's offer to compensate the lender), the beneficial effect on the bidding would not exist.

[18] If the winner's bid and signal are unobservable, then risky lending becomes infeasible: Given any $s_1 > \underline{t}$, any risky lending contract under which the lender breaks even is strictly advantageous for bidder 1 with signal realizations smaller than s_1.

5 The Optimal Stapled Finance Package

We now analyze the solution to the seller's optimization problem. The seller's objective function can be rewritten as a function of the cut-off signal $\widehat{s}$, only. We can rearrange Eqn. (3), to obtain

$$R^D_{\widehat{s}} + \mathcal{V}^D_{\widehat{s}} = \int_{\underline{t}}^{\widehat{s}} \int_{s_1}^{\widehat{s}} \varphi\left(s_2 - s_1\right) f(s_2) ds_2\, f(s_1) ds_1 + \big(1 - 2F(\widehat{s})\big) \int_{\underline{t}}^{\widehat{s}} \varphi\left(\widehat{s} - s\right) f(s) ds + R^{noD}. \tag{5}$$

Since R^{noD} (the seller's expected price in the absence of stapled finance) is constant, it does not affect the maximization problem. Take the derivative with respect of $\widehat{s}$ to obtain the first-order condition,

$$\big(1 - 2F(\widehat{s})\big)\, F(\widehat{s}) - f(\widehat{s}) \int_{\underline{t}}^{\widehat{s}} \left(\widehat{s} - s\right) f(s) ds = 0. \tag{6}$$

The optimal value $\widehat{s}^{opt}$ must lie below the median, since the first term of the first-order condition must be positive at the optimum (we had also shown this in the proof of Proposition 2). It is readily verified that the first-order condition is negative at the median and above, and that it is satisfied at the lower bound of the support, $\underline{t}$. The objective function must be increasing for low values of $\widehat{s}$, since it is weakly convex in $\underline{t}$ (as can be verified after taking derivatives a second time). So there must exist a local maximum lying between $\underline{t}$ and the median.

Proposition 7 *If F is log-concave and $\frac{\partial}{\partial s} f(s) \geq 0$ for all s below the median, then there exists a unique optimal value $\widehat{s}^{opt}$; $\widehat{s}^{opt}$ is larger than $\underline{t}$ and smaller than the median.*

Proof. Rearrange (6), by dividing both sides by $F(\widehat{s})$ and $f(\widehat{s})$: (assuming that $\widehat{s} > \underline{t}$)

$$\frac{1 - 2F(\widehat{s})}{f(\widehat{s})} - \frac{\int_{\underline{t}}^{\widehat{s}} \left(\widehat{s} - s\right) f(s) ds}{F(\widehat{s})} = 0. \tag{7}$$

Since $\frac{\partial}{\partial \widehat{s}} f(\widehat{s}) \geq 0$ for all $\widehat{s}$ below the median, the first term is decreasing in $\widehat{s}$ for all $\widehat{s}$ below the median. The second term is weakly increasing in $\widehat{s}$ if

$$\frac{\partial}{\partial \widehat{s}} \frac{\int_{\underline{t}}^{\widehat{s}} (\widehat{s} - s) f(s) ds}{F(\widehat{s})} = \frac{[F(\widehat{s})]^2 - f(\widehat{s}) \int_{\underline{t}}^{\widehat{s}} F(s) ds}{[F(\widehat{s})]^2} \geq 0$$

That is the case if $\int_{\underline{t}}^{\widehat{s}} F(s)ds$ is log-concave, which is implied by the log-concavity of F (see An (1998), Lemmas 2 and 3). So the first term in (7) is decreasing over the relevant range of $\widehat{s}$, and the second term increasing. Hence, there can exist at most one value of $\widehat{s}$ where the two terms are equal and the first-order condition is satisfied (again, ignoring $\widehat{s} = \underline{t}$, which is a local minimum). Since the first-order condition is positive for low values of $\widehat{s}$ and negative at the median and above, an optimum must exist, and it must lie between $\underline{t}$ and the median. ■

The two conditions stated in Proposition 7 are sufficient but not necessary for the uniqueness of an optimum. Log-concavity is a mild assumption, that is satisfied by most commonly used distribution functions (see Bagnoli and Bergstrom (1989)). The second condition, $\frac{\partial}{\partial s} f(s) \geq 0$ for all s below the median, excludes distributions that are everywhere decreasing and many distributions that are positively skewed. These two conditions are not needed for the result that the optimal value of $\widehat{s}$ lies strictly between $\underline{t}$ and the median of f, however (that result follows from Proposition 2).

The key variable in the seller's optimization problem is thus the cut-off signal $\widehat{s}$. Equivalently, the seller must choose the probability $F(\widehat{s})$ with which the financial buyer will accept the stapled finance, conditional on winning. The seller must arrange a stapled finance package (L, D), however. So far, we have shown that it is weakly optimal to set $L \leq D$ (see Lemma 1) and $D \geq \widehat{s}$ (see Lemmas 2 and 3), and that it is optimal to arrange at least some stapled finance (see Propositions 2 and 4). Thus, it is optimal to choose (L, D) such that $V(L, D, \underline{t}) < 0 \leq V(L, D, \overline{t})$.

We now analyze the characteristics of optimal (L, D) combinations. We can show that the seller can choose from a continuum of (L, D) combinations that all induce the same cut-off signal $\widehat{s}$. For any $\widehat{s} \in [\overline{t}, \underline{t}]$, fix any $D \in [\widehat{s}, \overline{t}]$, and find a corresponding value of L

such that the identity $V(L, D, \widehat{s}) = 0$ is satisfied:

$$L = \varphi\widehat{s} + (1-\varphi)\int_{\underline{t}}^{D} t_1 f(t_1)dt_1 + (1-\varphi)\int_{D}^{\overline{t}} Df(t_1)dt_1. \tag{8}$$

Thus, there exists a continuum of (L, D) combinations that yield the same cut-off signal $\widehat{s}(L, D)$. That is consistent with Eqn. (5), which describes the seller's expected net payoff as a function of $\widehat{s}$, only, i.e., such that the specific values of L and D that yield this cut-off signal are not relevant. It follows from Eqn. (8) that, holding $\widehat{s}$ constant, L is an increasing function of D (implicit differentiation shows that the slope is $(1-\varphi)(1-F(D))$). The optimal (L, D) combinations lie on an upward-sloping curve in the interior of the $[\underline{t}, \overline{t}] \times [\underline{t}, \overline{t}]$ space: One possible optimal value of D is $D = \overline{t}$; and given the optimal value of $\widehat{s}$, the corresponding optimal value of L (satisfying Eqn. (8)) is $\varphi\widehat{s} + (1-\varphi)E[t_1] \in (\underline{t}, \overline{t})$.

The seller can thus arrange different combinations of (L, D) that are optimal. For example, she could maximize the financial leverage that is being offered to the financial buyer: Given the optimal $\widehat{s}^{opt}$, the *largest* optimal loan is

$$\begin{aligned} \overline{L}^{opt} &= \varphi\widehat{s}^{opt} + (1-\varphi)E[t_1] \\ \overline{D}^{opt} &= \overline{t} \end{aligned}$$

Such a loan may be larger than the unconditional expected value of the target, and in practice, a seller may prefer to offer stapled finance packages that seem "reasonable" to outsiders. The *smallest* optimal (L, D) combination is found by setting $D = \widehat{s}$: As L and D are decreased while maintaining $\widehat{s}$ at its optimal level $\widehat{s}^{opt}$, D must eventually equal $\widehat{s}^{opt}$. At that point, we have $V(L, D, D) = 0$, so the financial buyer accepts the stapled finance if $s_1 < D$ and rejects it otherwise. As before, the corresponding value of L is found using the $V(L, D, D) = 0$ condition (see Eqn. (8)). So given the optimal $\widehat{s}^{opt}$, the *smallest* optimal loan is

$$\begin{aligned} \underline{L}^{opt} &= \varphi\widehat{s}^{opt} + (1-\varphi)E\left[\min\left\{t_1, \widehat{s}^{opt}\right\}\right] \\ \underline{D}^{opt} &= \widehat{s}^{opt} \end{aligned}$$

Recall that $\widehat{s}^{opt}$ lies below the median. Thus, since $\underline{L}^{opt} < \underline{D}^{opt} = \widehat{s}^{opt}$, it is optimal to offer a loan that is smaller than the median unconditional valuation of the target.

The seller thus has some leeway to tailor the optimal stapled finance package to the situation at hand. That is, the seller can choose an (L, D) combination that matches the financial leverage that financial buyers typically take on. Nevertheless, there is always a chance that the outcome of a bidding contest makes the stapled finance package look overly generous. Specifically, the price that the winning bidder has to pay may be smaller than the amount she can borrow. Of all the variables that are relevant in a bidding contest, these two (the winner's price, and the amount of debt she takes on) are the most likely to be observable, more likely, say, than the unconditional expected value of the target, a bidder's expected valuation, or even her bid. Given the secrecy that surrounds private equity funds and their transactions, that makes it hard to judge how aggressive observed stapled finance offers really are. However, in practice, stapled finance packages may be less extreme. That the price can be below L, the amount borrowed, is an artifact of our assumption that the lender commits to a loan (L, D), without any further conditions. In practice, a lender might cap the size of the loan at (or below) the price that the winner has to pay. This would complicate the analysis considerably, but our results should remain valid. The key result that the seller benefits from arranging stapled finance is driven by the optionality of stapled finance, i.e., that the winning bidder has the right (but not the obligation) to accept a loan whose terms are pre-specified. Even with more complicated conditions, a bidder can predict whether she will find the stapled finance terms advantageous or not; and if they are, she will accept the offer, and the benefit will be reflected in her bid.

Our model thus suggests that stapled finance packages may seem aggressive on two measures: The promised repayment (the coupon) may seem small to outside observers, compared with the loan that was taken out; and the size of the loan itself may seem large. In our model, these two measures of aggressiveness are two sides of the same coin, of course: Given the optimal $\widehat{s}$, the seller chooses one of the two variables L and D, and the identity $V(L, D, \widehat{s}) = 0$ (Eqn. (8)) then determines the other variable.

These results are consistent with the statements from practitioners that we cited in the Introduction, who called existing stapled finance packages "aggressive." Recall our result that by design, the lender must expect not to break even on the stapled finance package itself. If outsiders observe only the terms of the stapled finance package, but not the compensation that the seller promised for the expected loss on the loan, then it should not come as a surprise if these loans are called aggressive. Researchers should also expect to find that stapled finance loans perform much more poorly than other loans that were arranged to finance buyouts by financial buyers.

Similarly, outsiders may worry about the size of the loan. For instance, one partner of a private equity fund worried about "transactions where banks are willing to lend and private equity firms are put off because the staple finance package implies a valuation they're not comfortable with."[19] As we have shown, it is optimal to arrange a stapled finance package whose size may exceed the bidders' expected valuations, given the signals they observed. That is not the outcome the seller is hoping for, but she is willing to bear the risk, because of the beneficial effects that stapled finance has on the degree of competition in the bidding contest.

To end this section, let us compare the optimal stapled finance package that we just described with the optimal stapled finance package in the setup with two financial buyers.

Proposition 8 *Assume that both bidders are financial buyers, and that f is log-concave. Then there exists a unique optimal value $\widehat{s}_{D2}^{opt}$, which lies in $\left(\underline{t}, \overline{t}\right)$.*

Proof. The seller's objective function is equivalent (up to a constant) to (4). Taking derivatives and simplifying, we obtain the first-order condition:

$$2F(\widehat{s})\left(1 - F(\widehat{s})\right) - f(\widehat{s})\int_{\underline{t}}^{\widehat{s}} (\widehat{s} - s)\, f(s) ds = 0. \tag{9}$$

The first term is positive for all $\widehat{s} \in \left(\underline{t}, \overline{t}\right)$, and the second term is positive for all $\widehat{s} > \underline{t}$. In $\widehat{s} = \underline{t}$, the first-order condition is satisfied; in $\widehat{s} = \overline{t}$, the left-hand side is negative. It is readily checked that the second derivative is non-negative in $\widehat{s} = \underline{t}$, so the left-hand side

[19] See "Private equity in 2006: The year of living dangerously," *Financial News*, February 2006.

is positive for low values of $\widehat{s}$. Thus, there must exist a value of $\widehat{s} \in (\underline{t}, \overline{t})$ such that (9) is satisfied. Rewrite (9), assuming $\widehat{s} > \underline{t}$, as

$$2\frac{1 - F(\widehat{s})}{f(\widehat{s})} - \frac{\int_{\underline{t}}^{\widehat{s}} (\widehat{s} - s) f(s) ds}{F(\widehat{s})} = 0. \tag{10}$$

We have shown in the proof of Proposition 7 that the second term is non-increasing in $\widehat{s}$ if $\int_{\underline{t}}^{\widehat{s}} F(s)ds$ is log-concave, which is the case if F is log-concave; and that in turn is implied by our assumption that f is log-concave. The first term in (10) is decreasing in $\widehat{s}$ if

$$\frac{\partial}{\partial \widehat{s}} \frac{f(\widehat{s})}{1 - F(\widehat{s})} > 0,$$

which is the standard monotone hazard rate condition. It can easily be verified that it is satisfied if $(1 - F)$ is log-concave, which is the case if f is log-concave (see An (1998), Lemmas 2 and 3). ■

Thus, with two financial buyers the optimal value of $\widehat{s}$ may lie above the median. That is not necessarily the case, but we can show that it lies above the optimal value for the model with one financial buyer and one trade buyer.

Proposition 9 *If both bidders are financial buyers, then the optimal stapled finance package is more likely to be accepted by a given financial buyer than the optimal stapled finance package if there is one financial buyer and one trade buyer:* $\widehat{s}_{D2}^{opt} > \widehat{s}^{opt}$.

Proof. Compare the first-order conditions at $\widehat{s} = \widehat{s}^{opt}$, the optimal value with one financial buyer and one trade buyer. By construction, the first-order condition with one financial buyer and one trade buyer is satisfied:

$$\left(1 - 2F(\widehat{s}^{opt})\right) F(\widehat{s}^{opt}) - f(\widehat{s}^{opt}) \int_{\underline{t}}^{\widehat{s}^{opt}} \left(\widehat{s}^{opt} - s\right) f(s) ds = 0 \tag{11}$$

The first-order condition with two financial buyers, evaluated at $\widehat{s}^{opt}$, is

$$2F(\widehat{s}^{opt}) \left(1 - F(\widehat{s}^{opt})\right) - f(\widehat{s}^{opt}) \int_{\underline{t}}^{\widehat{s}^{opt}} \left(\widehat{s}^{opt} - s\right) f(s) ds.$$

Subtracting the left-hand side of (11), this equals $F(\widehat{s}^{opt})$, which is strictly positive (since $\widehat{s}^{opt} > \underline{t}$). Therefore, we must have $\widehat{s}_{D2}^{opt} > \widehat{s}^{opt}$. ∎

This result is consistent with our earlier finding, that the seller benefits more from stapled finance — and should therefore arrange larger stapled finance packages — when facing two financial buyers, than when facing a financial buyer and a trade buyer (Proposition 5). With two financial buyers, stapled finance increases the competition between the bidders by more, and it becomes easier for the seller to extract high prices from the bidders. It follows immediately from the optimality of offering stapled finance (Proposition 4) and the symmetry of the bidders that the bidders must be worse off from an ex-ante perspective. In other words, the financial buyers would be better off if the seller did not use stapled finance.[20] However, that is not their decision to make, and once stapled finance is available, the financial buyers will accept it if their signal realization is sufficiently low. Stapled finance thus turns the greed of financial buyers against themselves, making it possible for a seller to extract a higher price from them.

6 Conclusion

We have analyzed how the availability of stapled finance affects the price that can be expected in a takeover setting. When it is optimally designed, stapled finance is provided by a lender who expects not to break even on the loan, since the terms are fixed before the bidding start and the winner will accept the offer only if the terms are advantageous. The lender thus needs to be compensated by the seller for committing to providing the loan, but even after taking this compensation into consideration, the seller benefits from arranging stapled finance.

We have also shown that stapled finance is beneficial only in the presence of financial buyers in the bidding pool. It is optimal for the seller to arrange stapled finance such that trade buyers do not accept it, and therefore it does not affect their bidding strategy. In contrast, financial buyers accept the offer if their valuation of the target is sufficiently low,

[20] That is different in the setup with one financial buyer and one trade buyer, where the financial buyer benefits from the availability of stapled finance; see Proposition 3.

so their bidding becomes more aggressive. Intuitively, we find that stapled finance is most effective if the pool of bidders includes financial buyers, only.

Articles in the business press suggest that stapled finance is typically accepted by private equity funds, which is consistent with our results since these funds are typically regarded as financial buyers. LBO funds normally require that the firms they buy operate at high levels of financial leverage, but that is not the only reason for their interest in stapled finance: As we have shown, financial buyers accept the stapled finance if the terms are advantageous, given their value estimate.

The presence of financial buyers in the pool of bidders is thus good news to well-prepared sellers. When competing with a trade buyer, a financial buyer also benefits from the availability of stapled finance. However, if the competing bidder is also a financial buyer, then both bidders would prefer if stapled finance was not available (but if it is provided, the financial buyers will find it hard to resist the temptation). In practice, financial buyers themselves often arrange stapled finance when selling assets. That is not surprising, since buyout funds are sophisticated investors who buy and sell assets with high frequency, so they are well positioned to observe how stapled finance affects the bidding.

Some observers have worried about incentive problems in connection with the provision of stapled finance. First, some have argued that when competing for M&A advisory deals, investment banks have been offering stapled finance at terms that are far too aggressive. As we have shown, this is exactly how stapled finance should be provided. These aggressive terms are not evidence of excessive competition, but instead evidence of the sophistication of the institution (and its advisers) on the selling side.

Second, there have been concerns that the investment bank may push the seller to accept an offer from a bidder who is willing to accept the stapled finance package, because of the fees that investment banks earn for providing high-risk debt finance.[21] As we have shown, the investment bank expects not to break even and needs to be compensated by the seller. So if anything, there is reason to worry about the opposite, that the investment bank may favor a bidder who is *not* going to accept the stapled finance package. This is supported

[21] See, e.g., "Checkup prompts search for second opinions," *Wall Street Journal*, Jan 24, 2005, pg. C.1.

by the fact that after offering a stapled finance package, investment banks sometimes let other lenders "steal" their business. According to one observer, "Buyers don't always take the stapled finance [...] Once the stapled finance terms are public, other banks often emerge with better offers [...] The staple package is out there for every other financier to beat."[22] In many cases, the stapled finance terms may indeed be inferior to terms that can be negotiated after the bidding contest is over. However, given that the lender expects not to break even on the stapled finance itself, these price-cutting third-party lenders may at times unknowingly offer financing packages that are damaging their own financial health.

The chief executive of JPMorgan Chase, Jamie Dimon, recently commented on the willingness of investment banks to take risky financial stakes in buyouts.[23] Wall Street seems to have accumulated so-called "hung bridges", bridge loans that the banks were meant to sell in the markets but decided to keep on their own books. He warned that the stock equivalent of bridge loans, so-called "bridge equity" stakes, were "a terrible idea," and that he hoped that "they go the way of the dinosaur." Given our results, this is a valid assessment only if it considers those stakes in isolation. As we have shown, the investment bank advising the seller must offer the stapled finance package at advantageous terms, so by design it expects not to break even on those loans themselves. However, the banks remain willing to provide stapled finance as long as they are otherwise compensated for their losses.

It will be interesting to study the performance of buyout loans over the next few years, in particular loans from the riskier layers of stapled finance packages. Our model suggests that stapled finance loans will perform worse than other loans taken on to finance a buyout. Furthermore, we have shown that that financial buyers accept stapled finance only if their valuation is low enough. This suggests that the acquisitions that private equity funds financed using stapled finance packages should perform worse (in terms of operating profits, say) than acquisitions that were financed with third-party loans, or acquisitions made by trade buyers.

[22] See "'Stapled' loans create potential conflicts for merger advisers," *Bloomberg*, October 24, 2005 (citing a Citigroup banker).

[23] See "JPMorgan chief hits at help for buy-outs," *Financial Times*, July 19, 2007, pg. 23.

Appendix: Additional Proofs

Proof of Proposition 6

We first show that the equilibrium bidding and financing decisions must be fully separating; then we show what financing is available, given the observed bids and signals.

Suppose the equilibrium is not separating, i.e., suppose there is a set of signals S^p such that in equilibrium, bidder 1 uses the same bidding and financing strategy whenever $s_1 \in S^p$. Denote this strategy by b^p and (L^p, D^p). If $s_1 > D^p$ $\forall s_1 \in S^p$, then the lender expects to break even whenever a signal $s_1 \in S^p$ is realized. Hence, even if the bidder anticipates that she will accept a loan (L^p, D^p) if she wins, that has no impact on her bidding strategy. But then, the strategy is dominated for all $s_1 \in S^p$ such that $b^{noD}(s_1) \neq b^p$, so the strategy cannot be an equilibrium strategy. Now consider an equilibrium in which there exist $s_1 \in S^p$ such that $s_1 < D^p$. In equilibrium, the lender must expect to break even, and we must have $V(L, D, s_1) < 0$ for some $s_1 \in \left[\underline{t}, \bar{t}\right]$, and $V(L, D, s_1) > 0$ for some $s_1 \in \left[\underline{t}, \bar{t}\right]$. This is because there is a subset of S^p (including the lowest signals $s_1 \in S^p$) that includes signals for which $V\left(L^p, D^p, s_1\right)$ is strictly increasing. Consider the signal realizations such that $V(L, D, s_1) > 0$. Bidder 1 will decline any such loan in equilibrium, since the expected net payoff is negative for her, and, anticipating this, her bid would be reduced below the internally financed optimal bid $b^{noD}(s_1)$. But bidder 1 always declines the loan if $V(L, D, s_1) > 0$, then the lender cannot break even, so this cannot be an equilibrium.

We now describe how much debt can be raised after the bidding contest is over. (The same results hold if a bidder negotiates a loan commitment while preparing a bid.) It is straightforward to show that along the fully-separating equilibrium path, the lender's expected net payoff is zero for any signal realization (see the end of this proof). Hence, the financing decision does not affect the bidder's payoff. We have not modeled a reason to take on debt, so taking on debt as described is only weakly optimal, but not strictly optimal. All strategies that deviate from the separating equilibrium must be checked. Deviations at the borrowing stage will not occur if there were no earlier deviations (the lender can then infer both signals from the observed bids). The analysis of deviations at the bidding stage is somewhat more involved, since bidder 1 may deviate at this stage to get benefits at the borrowing stage (by misleading the lender about her type). This possibility limits the size of the loan.

Along the equilibrium path, we always have $V\left(L(s_1,s_2),D(s_1,s_2),s_1\right)=0$. Bidder 1's expected payoff at the bidding stage, given s_1, then is

$$\int_{\underline{t}}^{s_1} \varphi\left(s_1-s_2\right) f(s_2)ds_2$$

The available deviation strategies include bids that bidder 1 would choose with other signal realizations. We thus need to check the incentive compatibility constraints for "downward" and "upward" deviations. The bid with a signal realization s_1 will *not* be mimicked by $s_1^- < s_1$ if

$$\int_{\underline{t}}^{s_1^-} \varphi\left(s_1^- - s_2\right) f(s_2)ds_2 > \int_{\underline{t}}^{s_1} \left(\varphi\left(s_1^- - s_2\right) - V\left(L(s_1,s_2),D(s_1,s_2),s_1^-\right)\right) f(s_2)ds_2$$

That can be rewritten (using the break-even condition $V\left(L(s_1,s_2),D(s_1,s_2),s_1\right)\equiv 0$) as

$$\int_{\underline{t}}^{s_1^-} \left(s_1^- - s_2\right) f(s_2)ds_2 > \int_{\underline{t}}^{s_1} \left(\left(s_1^- - s_2\right) - \min\left\{s_1^-,D(s_1,s_2)\right\} + \min\left\{s_1,D(s_1,s_2)\right\}\right) f(s_2)ds_2$$
$$\int_{s_1^-}^{s_1} \left(s_2 - s_1^-\right) f(s_2)ds_2 > \int_{\underline{t}}^{s_1} \left(\min\left\{s_1,D(s_1,s_2)\right\} - \min\left\{s_1^-,D(s_1,s_2)\right\}\right) f(s_2)ds_2$$

If $s_1^- < s_1 \leq D(s_1,s_2)$ then the IC is certainly violated:

$$\int_{s_1^-}^{s_1} \left(s_2 - s_1^-\right) f(s_2)ds_2 < F(s_1)\left(s_1 - s_1^-\right) \iff -\int_{s_1^-}^{s_1} \left(s_1 - s_2\right) f(s_2)ds_2 < F(s_1^-)\left(s_1 - s_1^-\right).$$

If $s_1^- < D(s_1) < s_1$, then the IC is satisfied if

$$\int_{s_1^-}^{s_1} \left(s_2 - s_1^-\right) f(s_2)ds_2 > \int_{\underline{t}}^{s_1} \left(D(s_1,s_2) - s_1^-\right) f(s_2)ds_2.$$

If $D(s_1,s_2) < s_1^- < s_1$, then the IC is always satisfied. (Requiring that $D(s_1,s_2) < s_1^- \ \forall s_1^- < s_1$ is equivalent to requiring that $D(s_1,s_2) < \underline{t}$, so it excludes risky debt.) So we need to focus on this IC:

$$\int_{s_1^-}^{s_1} \left(s_2 - s_1^-\right) f(s_2) ds_2 > \int_{\underline{t}}^{s_1} \left(D(s_1, s_2) - s_1^-\right) f(s_2) ds_2 \ \ \forall s_1^- < s_1$$

There is no benefit from making $D(s_1, s_2)$ contingent on s_2, since all bids are observable. (If the winning bid was unobservable, it might help to condition $D(s_1, s_2)$ on s_2, since the losing bid provides a lower bound to the winner's signal.) So there is no loss of generality in rewriting the IC as an upper bound on the repayment $D(s_1)$ that can be promised:

$$D(s_1) \leq s_1^- + \frac{1}{F(s_1)} \int_{s_1^-}^{s_1} \left(s_2 - s_1^-\right) f(s_2) ds_2 \ \ \forall s_1^- < s_1$$

The RHS is increasing in s_1^-, so the only binding IC is that for $s_1 = \underline{t}$; that yields an upper bound for the promised repayment, $D(s_1) = E\left[t_1 | t_1 < s_1\right]$.

Now consider the downward IC, i.e., if a signal s_1^+ is realized, the bidder should not mimic the strategy she would pick with a realization $s_1 < s_1^+$. This IC is satisfied if

$$\int_{\underline{t}}^{s_1^+} \varphi\left(s_1^+ - s_2\right) f(s_2) ds_2 > \int_{\underline{t}}^{s_1} \left(\varphi\left(s_1^+ - s_2\right) - V\left(L(s_1), D(s_1), s_1^+\right)\right) f(s_2) ds_2$$

$$\int_{\underline{t}}^{s_1^+} \left(s_1^+ - s_2\right) f(s_2) ds_2 > \int_{\underline{t}}^{s_1} \left(\left(s_1^+ - s_2\right) - \min\left\{s_1^+, D(s_1)\right\} + \min\left\{s_1, D(s_1)\right\}\right) f(s_2) ds_2$$

The upward IC requires that $D(s_1) \leq E\left[t_1 | t_1 < s_1\right] < s_1$, so $D(s_1) < s_1^+$ and the IC is

$$\int_{\underline{t}}^{s_1^+} \left(s_1^+ - s_2\right) f(s_2) ds_2 > \int_{\underline{t}}^{s_1} \left(s_1^+ - s_2\right) f(s_2) ds_2.$$

Since $s_1 < s_1^+$, that is always satisfied.

Finally, the size of the loan, $L(s_1)$, can be derived by solving $V\left(L(s_1), D(s_1), s_1\right) = 0$ for $L(s_1)$. ■

References

An, Mark (1998), 'Logconcavity versus logconvexity: A complete characterization', *Journal of Economic Theory* **80**, 350–369.

Bagnoli, Mark and Ted Bergstrom (1989), Log-concave probability and its applications. Mimeo, University of Michigan.

Bargeron, Leonce, Frederik Schlingemann, René Stulz and Chad Zutter (2007), Why do private acquirers pay so little compared to public acquirers? Mimeo, University of Pittsburgh and Ohio State University.

Bhattacharyya, Sugato (1992), The analytics of takeover bidding: Initial bids and their premia. Working Paper, Carnegie Mellon University.

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

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

Clayton, Matthew and Abraham Ravid (2002), 'The effect of leverage on bidding behavior: Theory and evidence from the FCC auctions', *Review of Financial Studies* **15**, 723–750.

Crémer, Jacques (1987), 'Auctions with contingent payments: Comment', *American Economic Review* **77**, 746.

Daniel, Kent and David Hirshleifer (1992), A theory of costly sequential bidding. Working Paper, Anderson Graduate School of Management, UCLA.

DeMarzo, Peter, Ilan Kremer and Andrzej Skrzypacz (2005), 'Bidding with securities: Auctions and security design', *American Economic Review* **95**, 936–959.

Fishman, Michael (1988), 'A theory of pre-emptive takeover bidding', *Rand Journal of Economics* **19**, 88–101.

Fishman, Michael J. (1989), ‘Preemptive bidding and the role of the medium of exchange in acquisitions’, *Journal of Finance* **44**, 41–57.

Hansen, Robert (1985), ‘Auctions with contingent payments’, *American Economic Review* **75**, 862–865.

Harris, Milton and Artur Raviv (1988), ‘Corporate control contests and capital structure’, *Journal of Financial Economics* **20**, 55–86.

Israel, Ronen (1991), ‘Capital structure and the market for corporate control: The defensive role of debt financing’, *Journal of Finance* **46**, 1391–1409.

Israel, Ronen (1992), ‘Capital and ownership structures, and the market for corporate control’, *Review of Financial Studies* **5**, 181–198.

Jensen, Michael (1986), ‘Agency costs of free cash flow, corporate finance and takeovers’, *American Economic Review* **76**, 323–29.

Müller, Holger and Fausto Panunzi (2004), ‘Tender offers and leverage’, *Quarterly Journal of Economics* **119**, 1217–1248.

Povel, Paul and Michael Raith (2004), ‘Optimal debt with unobservable investments’, *Rand Journal of Economics* **35**, 599–616.

Povel, Paul and Rajdeep Singh (2004), ‘Using bidder asymmetry to increase seller revenue’, *Economics Letters* **84**, 17–20.

Povel, Paul and Rajdeep Singh (2006), ‘Takeover contests with asymmetric bidders’, *Review of Financial Studies* **19**, 1399–1431.

Povel, Paul and Rajdeep Singh (2007), ‘Sale-backs in bankruptcy’, *Journal of Law, Economics and Organization* **23**, forthcoming.

Ravid, Abraham and Matthew Spiegel (1999), ‘Toehold strategies, takeover laws and rival bidders’, *Journal of Banking and Finance* **23**, 1219–42.

Rhodes-Kropf, Matthew and S. Viswanathan (2000), 'Corporate reorganizations and non-cash auctions', *Journal of Finance* **55**, 1807–49.

Rhodes-Kropf, Matthew and S. Viswanathan (2004), 'Market valuation and merger waves', *Journal of Finance* **59**, 2685–2718.

Rhodes-Kropf, Matthew and S. Viswanathan (2005), 'Financing auction bids', *Rand Journal of Economics* **36**, 789–815.

Riley, John (1988), 'Ex post information in auctions', *Review of Economic Studies* **55**, 409–430.

Samuelson, William (1987), 'Auctions with contingent payments: Comment', *American Economic Review* **77**, 740–745.

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

Stulz, René (1988), 'Managerial control of voting rights: Financing policies and the market for corporate control', *Journal of Financial Economics* **20**, 25–54.

Zheng, Charles (2001), 'High bids and broke winners', *Journal of Economic Theory* **100**, 129–171.