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Abstract

An important yet understudied aspect of mergers and acquisitions is the selling procedure. This paper compares a seller’s revenue in a standard English ascending auction to that in a negotiation with a “go-shop” provision. In the latter, the target privately negotiates with a few bidders, signs a tentative merger agreement with one of them, and then publicly solicits additional bids during a “go-shop” period. Using a theoretical framework, I show that a “go-shop” negotiation generates higher seller revenue than does an auction, when first, the bidders’ costs of learning their valuations are sufficiently high, second, the bidders’ valuations are moderately correlated with each other, and third, the bidders’ prior probabilities of the existence of gains from trade are sufficiently low. The theoretical results are broadly consistent with empirical evidence, and they provide a novel explanation for the prevalence of “go-shop negotiations” in private equity deals.

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1 Introduction

The procedures by which companies are sold in mergers and acquisitions (M&A) take varying forms. Of particular interest is the prevalence of two forms: first, an English ascending auction and second, a negotiation with a “go-shop” provision. While the former procedure has historically been more prevalent, the “go-shop negotiation” procedure has become more popular since its emergence in a 2004 private equity deal.

As a recent example of a traditional English ascending auction, consider the merger between two healthcare companies. On August 18th, 2015, the board and the senior management of the target company, Sequenom, decided to pursue a business combination in the form of a sale to a strategic buyer. The sale process began when the target firm hired the investment bank J.P. Morgan Securities to publicly solicit bids from 25 potential strategic bidders. The target then held an auction at which all interested buyers submitted their bids. Finally, the target signed a merger agreement with the bidder that submitted the highest bid of $2.4 per share, Laboratory Corporations of America Holdings, and the deal was settled. This type of mechanism is also called a “pre-signing market check,” because most market checks are conducted before signing a merger agreement.

The other selling procedure, a go-shop negotiation, emerged a few years prior to the 2006-2008 leveraged buyout boom. In this procedure, an English ascending auction is preceded by a first round negotiation, in which an initial offer is made, and a break-up fee is promised to the initial bidder if the target switches to another buyer later. An example of this is the sale of CKE Restaurants to a private equity firm, Apollo Management. In September 2009, three private equity firms expressed interest in buying the target. The target’s board then set up a special committee to privately negotiate with each of the private equity firms. At the completion of the negotiation, the target signed a tentative merger agreement with the highest bidder from amongst the three, Thomas H. Lee Partners. The agreement specified the following: first, a minimum bid $11.05 per share for that bidder; second, the target’s right to solicit other bids in a go-shop period after announcing the agreement; and third, a termination fee to Thomas H. Lee in the event that the target was sold to another buyer during the go-shop period. Then, the target publicly announced the merger agreement in a press release. During the subsequent 40-day go-shop period, the target hired investment bank UBS to contact 24 private equity firms and four potential strategic buyers.

1Strategic buyers are usually corporate buyers that look for companies that will create a synergy with their existing businesses.
and solicited their interest in making a higher proposal. Among them, a private equity firm, Apollo Management, topped the original offer with a bid of $12.55 per share; an offer with which Thomas H. Lee was not able to compete. As a result, Apollo Management won the deal, while the target paid the termination fee to the initial bidder. Practitioners also refer to such mechanism as a “post-signing market check”, because most market checks are conducted after signing a tentative merger agreement.

Standard ascending auctions have been a traditional selling mechanism which have been used in 36% of M&A deals between 2003 and 2015. A go-shop negotiation, on the other hand, represents a relatively new mechanism. Having originated with deals involving private equity buyers, go-shop negotiations currently continue to be more prevalent in deals attracting financial buyers, the majority of which are private equity firms. Empirical evidence suggests that the prevalence of go-shop negotiations is higher in deals attracting mostly financial buyers (16%) than in deals attracting mostly strategic buyers (3%). The frequency of use of this mechanism has reached 22% in 2015 among deals attracting mostly financial buyers. The frequency of the use of a go-shop negotiation in the period 2003-2005 has also been higher in bankruptcy sales under Section 363 of Chapter 11 (84%) than in non-bankruptcy M&As (5%). In addition, use differs across target industries.

The empirical evidence motivates two questions: first, why are both auctions and go-shop negotiations observed in practice? and second, why do we observe cross-sectional variations in the use of go-shop negotiations?

Conventional wisdom explains the use of standard ascending auctions, while attributing the use of go-shop negotiations to agency conflicts. Bulow and Klemperer (2009) suggest that an auction generates higher revenue for the seller because it increases bidder participation. Denton (2008) believes that a target management chooses a go-shop negotiation so as to favor a particular bidder, which may have promised

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2Source of data: MergerMetrics.

3The gains from trade between a strategic buyer and the target comes from combining the two businesses. The gains from trade between the target and a financial buyer stems from the financial buyer’s ability to improve the target’s value, by restructuring the target with acquisitions and sales, as well as by improving the target’s corporate governance and capital structure. See Guo, Hotchkiss and Song (2011).

4Source of Data: MergerMetrics, 2003-2015. As the research of Gorbenko and Malenko (2014) shows, deals won by a financial (strategic) buyer attract mostly financial (strategic) bidders. In addition, analysis of the MergerMetrics database (2003-2015) implies that the frequency of use of this mechanism is much higher if the deal is won by a financial buyer (16%) than if the deal is won by a strategic buyer (3%). Therefore, go-shop negotiations are more frequently used in deals attracting mostly financial buyers than in those attracting mostly strategic buyers.


6In particular, the frequency of use of go-shop negotiations is high if the target is in Consumer Durables, Consumer Non-Durables, and Retail Trade (11%), and it is lower in High-Tech, including Technology Services, Electronic Technology, and Health Technology (3%). Source of Data: MergerMetrics, 2003-2015.
the management a large compensation package.\footnote{The author believes that the go-shop period in the go-shop negotiation mechanism is essentially “window-dressing” to reduce litigation risk. See also Antoniades, Calomiris, and Hitscherich (2013) regarding litigation risk concerns.} It has also been heavily debated in courts of law as to whether or not a go-shop negotiation mechanism has fulfilled the \textit{Revlon} duties that require the target management to maximize the shareholders’ value.\footnote{See Subramanian’s (2008) comparison of the Delaware Chancery Court’s decision on \textit{In re Topps Company Shareholders Litigation} and on \textit{In re Lear Corporation Shareholder Litigation}.}

This paper is one of the first theoretical works to capture the institutional features of go-shop negotiations, and it suggests an alternative explanation for the use of go-shop negotiations. That is, when information acquisition is costly, a go-shop negotiation generates higher seller revenue than does a standard auction by inducing higher bidder participation. In such a mechanism, the target compensates one bidder to conduct costly information acquisition first and to make a public bid. The initial bid, if high enough, will reveal the attractiveness of this deal to other similar buyers for free, and will therefore improve bidder participation for this deal. In addition, the target compensates the first bidder for being free-ridden with a termination fee.

In particular, I build a model in which there are two potential bidders and one seller. It is costly for bidders to learn their values for the target firm, and these values are positively correlated. In addition, there is uncertainty about the existence of gains from trade. I show in the benchmark model that the seller’s revenue in a go-shop negotiation is strictly higher than it would be in an English ascending auction when: (i) bidders’ costs of learning their values for the target firm are sufficiently high; (ii) bidders’ values for the target firm are sufficiently correlated, but not too highly correlated; and (iii) bidders’ prior probabilities regarding the existence of gains from trade are low enough that no potential bidder would make a serious bid\footnote{Here, a serious bid refers to a bid that exceeds the target’s stand-alone value.} without knowing the existence of gains from trade.

I further show that the preferential treatment involves both a \textit{transfer} from the seller to the first bidder in the form of a termination fee, and an \textit{inefficient allocation rule} that assigns the target firm to the initial bidder more often than to the second bidder. In fact, such preferential treatment in favor of the first bidder is \textit{inevitable} whenever the optimal go-shop negotiation outperforms the optimal ascending auction. The reason is as follows. A strictly positive transfer in the form of a termination fee is needed to compensate the initial bidder for providing the information externality. However, as a result, the target also has to be sold to the initial bidder more often, in order to make the first bid informative about the existence of gains from trade. Or else, the initial bidder who discovers that the target firm is not worth...
buying would pretend that it is, so as to obtain the termination fee for free.

The key results of the benchmark model are confirmed by a more elaborate model with normally distributed bidder values and more natural assumptions regarding information technology. I then show that, if the bidders’ values for the target firm are less correlated, a go-shop negotiation dominates a standard auction within a smaller range of parameters.

The key empirical implication of the model is that go-shop negotiations are used more often than English ascending auctions when bidders’ values for the target firm are more correlated. The intuition is that when the bidders’ valuations are similar enough, the new bidders find the first bid informative about their own valuations. This prediction provides a novel explanation for the prevalence of go-shop negotiations among deals attracting mostly private equity buyers. Intuitively speaking, the valuations of private equity buyers are similar due to similar business models. The result is broadly consistent with the empirical evidence based on the hand-collected data provided by the authors of Gorbenko and Malenko (2014) and the data from MergerMetrics between 2003 and 2015.

The intuition for the key results is as follows. When bidders’ prior probabilities of gains from trade are low, no bidder will make a serious bid without knowing the existence of gains from trade. This could generate a problem for an English ascending auction, where information acquisition by bidders is simultaneous. In particular, when information acquisition is too costly compared to the expected profit from the bidding game, the competition among bidders leads to little incentive for all bidders to acquire information at the same time. This may occur due to a high information cost of learning the existence of gains from trade, a pessimistic prior probability of the existence of gains from trade, or an exceedingly high correlation between the bidders’ values for the seller’s firm. As a result, there is little bidder participation, and the seller’s revenue is low.

The problem could potentially be alleviated in go-shop negotiations, where information acquisition is sequential. In this mechanism, the seller first incentivizes one bidder to acquire the information about the existence of gains from trade by promising that bidder a termination fee. By announcing the first bid, the seller then reveals the information acquired by the first bidder to the second potential bidder. If the bidders’ values for the target firm are sufficiently highly correlated, the second potential bidder


\[1^{11}\] Source of data: SDC.

\[1^{12}\] When the correlation is too strong, the bidding game – if both bidders acquire information – is similar to a Bertrand competition. Therefore, the information rent given to each bidder would be low. The intuition as to why a high correlation of bidder values leads to low bidder information rent is similar to that of the Linkage Principle in Milgrom and Weber (1982).
becomes informed of the existence of gains from trade for free by learning that the first bidder’s value is sufficiently high. This potentially raises bidder participation relative to the case of English ascending auctions. When the benefit of more bidders being informed of the existence of gains from trade outweighs the cost of preferential treatment to the first bidder, the seller’s revenue is higher in go-shop negotiations.

If, however, the bidders’ values are excessively correlated, go-shop negotiations can no longer improve upon English ascending auctions. This is because the second stage is similar to Bertrand competition. Expecting a very low profit from the second stage auction, the second bidder will not enter the game even knowing there are gains from trade. This result is consistent with the fact that go-shop negotiations are not used in the sale of oil lease contract. \(^{13}\)

I further consider an extension in which the mechanism is the result of a negotiation between the seller and the first bidder. The main results hold qualitatively in this extension, as well as in additional variations of the model.

Finally, in addition to the empirical finding that links the intra-deal correlation of bidder valuations to more use of go-shop negotiations, I present additional empirical evidence on the alternative hypotheses that first, go-shop negotiations are driven by a bidder with strong bargaining power, and second, the target management uses a go-shop negotiation to favor one bidder while sacrificing shareholder value. The empirical evidence suggests that the former hypothesis is not plausible, though the latter may play a role in Management Buyouts where agency conflicts are potentially salient. However, the agency conflicts hypothesis is unlikely to be the entire story, because Management Buyouts are only a small fraction of all deals using a go-shop negotiation.

The rest of the paper is organized as follows. Following a literature review, Section 2 describes the model setup. Section 3 finds the optimal ascending auction and go-shop negotiation mechanisms, and compares the seller’s revenues between the two. Section 4 considers extensions. Section 5 empirically examines the implications of the model and alternative hypotheses. Section 6 concludes. The Appendices provides the proof and additional empirical evidence.

**Related Literature** To the knowledge of the author, this is one of the first formal models that captures the institutional features of go-shop negotiations observed in practice. The only other theoretical work that also studies go-shop negotiation is Roberts and Sweeting (2013), but they didn’t capture the key feature of such mechanism: the termination fee.

\(^{13}\)See Hendricks and Porter (2014).
Nonetheless, the paper is related to the literature on sequential negotiations featuring preemptive bidding, including Fishman (1988), Bulow and Klemperer (2009), and also Roberts and Sweeting (2013). These papers show that a high first bid would preempt information acquisition by the second bidder, under the assumptions that it is costly for the bidders to learn the idiosyncratic part of their values, termination fees are not allowed, and the first bidder is free to make any bid. This paper, however, assumes that it is costly to learn the part of the gains from trade shared by both bidders. Therefore, preferential treatment such as termination fees are essential in order to incentivize the first bidder to conduct costly information acquisition and to provide an information externality to the second bidder. In addition, this paper assumes that the seller only allows the first bidder to decide whether or not to bid above a certain threshold, without revealing the actual bid. This assumption makes preemptive bidding less of a concern, and permits the focus to remain on the key channel of the paper. Finally, this paper shows that a sequential negotiation generates higher seller revenue than a standard auction because it increases bidder participation. However, in Bulow and Klemperer (2009), a sequential negotiation is dominated by a standard auction because it reduces bidder participation.

This paper is also related to other works on sequential mechanisms. In an environment without endogenous information acquisition, Povel and Singh (2006) show that if both bidders are already informed, and the information of one bidder is more important to both bidders, then the optimal mechanism for the seller is a sequential bidding game. Betton, Eckbo, and Thorburn (2009) consider a sequential negotiation model of hostile takeover with independent bidder values and toehold. Glode and Opp (2016) study the trading protocol for the sale of a financial asset. They compare the social welfare between a sequential trading game and a static auction, in a setting where the two buyers’ and the seller’s values for the security are interdependent. On the contrary, my paper aims to explain corporate transactions. Therefore, I assume that the seller’s stand-alone value (market capitalization before merger) is common knowledge, where the bidders’ values are potentially correlated. In addition, I focus on seller revenue optimization instead of social welfare.

This paper is also related to the following studies on the benefit of information revelation. Milgrom and Weber (1982), and Eso and Szentes (2007) investigate the information disclosure in auctions, and show that more information revelation increases the seller’s revenue. Duffie, Dworczak and Zhu (2015) consider a search model of the trading of financial assets, and they show that revealing the common cost of sellers could increase investor participation. Sherman and Titman (2002) and Sherman (2005) investigate
the IPO book building. They show that IPO under-pricing serves to compensate the primary dealers for information acquisition about the quality of the issued equity, and such information is revealed to the secondary market investors by the bids of primary dealers. My paper differs because IPO under-pricing models involve both the primary market and the secondary market, while my model involves only the primary market.

Another related literature is mechanism design with information acquisition. Persico (2000) compares the amount of information acquisition in first-price and second-price sealed-bid auctions. Assuming the object will always be sold, Bergemann and Valimaki (2002) show that the information acquisition exceeds that of the social optimum in a standard English ascending auction when bidder values are independent. Assuming instead that the target firm is sold only if the price exceeds the target’s stand-alone value, my model shows that information acquisition is below the social optimum in a standard English ascending auction. Shi (2012) considers the optimal mechanism with information acquisition and private value, while this paper allows for correlated values.

The paper is also related to the theoretical works on correlated information, such as Cremer and McLean (1985) and (1988). However, my model also considers endogenous information acquisition, which is absent in their model.

The intuition of this paper is connected to the incomplete contract literature on exclusivity, such as McAfee and Schwartz (1994), and Segal and Whinston (2000). In both their literature and this paper, the certain extent of exclusivity reduces holdup problems and encourages agents to exert more effort. However, the non-contractible effort in the exclusivity literature usually refers to the investment to reduce production costs. In my model, such effort focuses on information acquisition. The nature of such effort leads to implications regarding information revelation and the correlation of bidder values, which were not present in the literature of exclusivity.

Other related theoretical works include multi-stage auctions such as Ye (2006), and tender offer auctions such as Schwartz (1986), and Berkovitch, Bradley and Khanna (1989).

Finally, the paper is connected to the following empirical studies. First, it is related to Gorbenko and Malenko (2014) who investigate the difference between financial bidders and strategic bidders. Second, it is connected to a (surprisingly) small empirical literature on go-shop provisions, which are a key feature of go-shop negotiations. Subramanian (2008) and Jeon and Lee (2014) claim that go-shop provisions may benefit the seller compared to deals with no-shop provisions. Denton (2008) states that
go-shop is chosen over standard auctions due to agency conflicts between the target management and the shareholders. Antoniades, Calomiris, and Hitscherich (2015) believe that the over-use of go-shops reflects excessive concerns about litigation risks, possibly resulting from lawyers’ conflicts of interest in advising targets. Other related empirical literature includes Boone and Mulherin (2007b) who compare multi-bidder takeover deals with single-bidder takeover deals, Boone and Mulherin (2007a) and Burch (2001) who examine termination fees and other deal protections, and Gilson, Hotchkiss and Osborn (2015) who discuss the “stalking horse bid” in the bankruptcy process.

2 Setup of the Benchmark Model

There are two potential bidders and one seller. It is costly for the potential bidders to learn their values for the target firm, and these values are positively correlated. In addition, there is uncertainty about the existence of gains from trade. In the benchmark case, I consider a model with the valuations following simple distributions such as binary and uniform. In Section 4.2, I will show that the key results in the benchmark model are confirmed by a more elaborate model with normally distributed valuations and more natural settings on information technology.

2.1 Valuations

The seller’s outside option if no sale is \( m \), which can be interpreted as the stock market capitalization. The outside options of the two bidders, if the transaction with the target does not occur, both take the value \( n \). \( m \) and \( n \) are common knowledge.

Bidder \( i \)'s value for the target firms is

\[
W_i = m + V + x_i, \ i = 1, 2
\]

Denote \( u_i \) as the gains from trade between bidder \( i \) and the target. That is, \( u_i \) is the difference between bidder \( i \)'s value for the target firm, and the target’s stand-alone value:

\[
u_i = V + x_i, \ i = 1, 2
\]

Such gains from trade consist of two pieces. The common piece, \( V \), is shared by all potential bidders,
and it is due to the common expertise among the two bidders. It follows a binary distribution:

\[
V = \begin{cases} 
Z, & \text{with probability } p \\
-Z, & \text{with probability } 1 - p 
\end{cases}
\]

with \(Z > 0\). The idiosyncratic piece is \(x_i \sim U [l, h]\), i.i.d., and is also independent to the common part, \(V\).

I make the following assumptions for the valuations.

**Assumption 1.** (common part as the indicator of gains from trade) \(Z + x_i > 0\), and \(-Z + x_i < 0\), \(\forall x_i \in [l, h]\).

**Assumption 2.** (uninformed buyer does not bid) \(E(V) + x_i < 0\), \(\forall x_i \in [l, h]\).

Assumption 1 implies that the variation of the common part dwarfs that of the idiosyncratic part, so that the common part is the indicator of the existence of the gains from trade. A direct implication of this assumption is that bidders’ values for the target firm are highly correlated. Assumption 2 states that, if a buyer does not know whether there exists gains from trade, the buyer will not make a bid that exceeds the target’s stand-alone value. This is true even if the realized idiosyncratic part reaches the highest value possible. That is, if a potential bidder neither pays the cost to acquire the information of the common part of the gains from trade nor learns about this information from others, the potential bidder effectively drops out from the bidding game. For this reason, the seller would like as many bidders to become informed about \(V\) as possible.

### 2.2 Information Technology

Without information acquisition, neither the seller nor the bidders know \(V\) or \(x_i, i = 1, 2\). The seller can invite bidders to conduct information acquisition. If invited, bidder \(i\) has the option to acquire information in the following order:

- If paying a cost \(c_V\), bidder \(i\) knows \(V\);
- Then, if paying a cost \(c_x\), bidder \(i\) knows \(x_i\), independent to whether bidder 1 has learned \(V\) or not.
The information is private to the bidder who acquired it. In addition, I follow the tradition of the literature of information acquisition, and assume that the action of information acquisition is non-observable by others. This is because an outsider cannot verify whether a bidder has exerted effort.

I make the following assumption about how the cost of information acquisition is allocated between learning about the common part and the idiosyncratic part.

**Assumption 3.** *(info acquisition mostly on common part)* \( c_V > 0, c_x = 0. \)

Assumption 3 states that the cost of information acquisition on the common part of the gains from trade is significant, while the idiosyncratic part of the gains from trade is negligible. This assumption is made in accordance with Assumption 1, following the logic that more (less) information acquisition effort is required if the amount of uncertainty is higher (lower). In addition, I consider the information acquisition of the common part \( V \) and the idiosyncratic part \( x_i \) separately. That is, it is possible that a bidder learns only \( x_i \) but does not exert the effort to learn \( V \). I also assume that the option to learn about the common part takes place before that of the idiosyncratic part of gains from trade for simplicity.

In Section 4.2, I will consider a model with a more natural setting on information acquisition technology and normally distributed valuations. I show with numerical examples that the key results in the benchmark models still hold.

Define *entry* for a bidder in this model as (i) the bidder has learned both \( V \) and \( x_i \), and (ii) the bidder submits a bid higher than the target’s stand-alone value (a serious bid). Under the settings above, knowing \( V \) is the necessary and sufficient condition for *entry* because the idiosyncratic part of gains from trade \( x_i \) is always learned and there is no additional logistic bidding cost. The information acquisition cost \( c_V \) is then equivalent to the entry cost.

### 2.3 The English Ascending Auction and Go-Shop Negotiation Mechanisms

I now make formal characterizations of the English ascending auction and go-shop negotiation mechanisms by specifying their timelines. In both mechanisms, the seller optimally chooses the parameters for the mechanism, announces the mechanism at the beginning, and commits to the announced mechanism throughout the game.

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\[\text{14}\] Hence, there would be no contingent information acquisition on the common part of gains from trade based on the value of \( x_i \). These assumptions allow me to focus on the information acquisition of the common part of the gains from trade, while avoiding analyzing the interaction between the information acquisition about the common part and the private part.

\[\text{15}\] For this reason, in my model, a high first bid does not deter entry by the second bidder.
A standard English ascending auction

- \( t = 0 \), the seller optimally chooses a reserve price \( r \), announces it and commits to it.

- \( t = 1 \), the seller invites both bidders for information acquisition, the technology of which is specified in Section 2.2.

- \( t = 2 \), the seller holds an English ascending auction with reserve price \( r \).

A go-shop negotiation

- \( t = 0 \), the seller optimally chooses the triplet of parameters \((b_1, TF, r_{B2})\), where \( b_1 \) is the minimum bid promised by the bidder 1, \( TF \) is the termination fee, and \( r_{B2} \) is the seller’s reserve price if bidder 1 is excluded from the game during the first stage of go-shop negotiation. The seller announces it and commits to it.

- \( t = 1 \), the seller invites bidder 1 for information acquisition, the technology of which is specified in Section 2.2.

- \( t = 1.5 \), bidder 1 decides whether to join the English auction happening at the final date and bid at least \( b_1 \), in exchange for the promise of a termination fee \( TF \). If bidder 1 agrees, the seller promises to pay bidder 1 a termination fee \( TF \) if bidder 1 loses the deal; otherwise, bidder 1 is excluded from the game, and the seller moves on to bidder 2.

- \( t = 1.75 \), the seller announces bidder 1’s decision of acceptance or rejection. Then, the seller invites bidder 2 to acquire information regardless, the technology of which is specified in Section 2.2.

- \( t = 2 \), If bidder 1 has been excluded from the game, the seller offers bidder 2 a take-it-or-leave-it price \( r_{B2} \). If bidder 1 is still in the game, the two bidders join an English ascending auction with a termination fee \( TF \) payable to bidder 1 if bidder 1 loses the deal. The reserve price is \( b_1 \) for bidder 1, and \( b_1 + TF \) for bidder 2. In addition, bidder 2 wins the deal if only if his bid exceeds bidder 1’s by at least \( TF \).

Figure 2.1 and 2.2 illustrate the timelines. The italic parts in Figure 2.2 are the key elements in go-shop negotiation that makes the mechanism different from a standard English auction.
The seller optimally chooses reserve price $r$, announces it and commits to it.

Each bidder $i$ first decides on learning $V$, then learns $x_i$ regardless.

The seller holds an English ascending auction with reserve price $r$.

Figure 2.1: Timeline: An English Ascending Auction

The seller invites both bidders for information acquisition.

Bidder 1 decides whether to promise to bid at least $b_1$, in exchange for a termination fee TF if losing the deal.

Yes: bidder 1 gets TF if not winning;
No: bidder 1 is excluded.

The seller then invites bidder 2 for information acquisition regardless.

Bidder 2 wins iff his bid exceeds bidder 1's by at least TF.

Figure 2.2: Timeline: Go-Shop Negotiation
Note that I assume the all the auctions to be English ascending auctions. In such auctions, the price continuously increases from the reserve price. A bidder drops out from the auction if the price exceeds the bidder’s willingness to pay. The bidders bid up the price until only one bidder remains. I assume an English auction because, with multiple rounds of bidding, a takeover auction in practice is more like an English auction compared to sealed-bid auctions (first price or second price) or a descending auction.16

I make the following two assumptions for both mechanisms.

**Assumption 4.** *Termination fee is non-negative.*

**Assumption 5.** *Reserve price is no lower than the target’s stand-alone value $m$.***

Assumption 4 is a common restriction in bidding games due to bidders’ concern about the bidding game being a scam. It is essentially a restriction of limited liability that implies no strictly positive entry fee. Assumption 5 is made because it is difficult for the seller to commit to sell at a price lower than its outside option.

3 Optimal English Auction and Go-Shop Negotiation, and Comparison between the Two

3.1 Seller’s Objective and Equilibrium Concept

The seller’s objective is to maximize revenue. If choosing an English ascending auction, the seller optimizes over the reserve price $r$; if choosing a go-shop negotiation, it optimizes over the triplet $(b_1, TF, r_{B2})$, which includes the minimum bids promised by the first bidder ($b_1$), the termination fee payable to the first bidder ($TF$), and the reserve price in the final stage auction if the first bidder is excluded ($r_{B2}$).

The equilibrium concept used in this model is Perfect Bayesian Nash Equilibrium. As for the equilibrium refinement criterion for multiple equilibria in the bidding stage, I consider the weakly dominant strategy equilibrium; for multiple equilibria in the information acquisition stage, I follow the tradition of mechanism design by assuming that the seller induces the most desirable equilibrium; if seller is indifferent among all equilibria, I assume that the seller chooses the equilibrium that is continuous in parameters.

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16 This view is shared by Gorbenko and Malenko (2014), who furthermore point out the complicated nature of the format of auctions used in mergers and acquisitions. Therefore, an English auction is only a reasonable approximation of the auction format observed in practice.
3.2 Seller’s Revenue in the Optimal Standard English Ascending Auction

Proposition 3.1 summarizes the seller’s revenue in the optimal English auction, and the corresponding equilibrium.

**Proposition 3.1.** The seller’s revenue under the optimal reserve price and the optimal equilibrium under the reserve price are:

1. when \( \frac{c_V}{p} \in \left[0, \frac{(h-l)}{6}\right] \), both bidders acquire information. The seller’s revenue is \( m + p \left(Z + l + \frac{h-l}{3}\right)\).

2. when \( \frac{c_V}{p} \in \left(\frac{(h-l)}{6}, \frac{\bar{c}}{p}\right] \), both bidders acquire information with probability \( 1 - \frac{6c_V - p(h-l)}{2p(h+2l+3Z)} \in (0,1) \). The seller’s revenue is \( m + \frac{3(p(h+l+2Z)-2c_V)^2}{4p(h+2l+3Z)} \).

3. when \( \frac{c_V}{p} \in \left(\frac{\bar{c}}{p}, \frac{(h-l)}{2}\right] \), only one bidder acquires information. The seller’s revenue is \( m + p(Z + l)\).

4. when \( \frac{c_V}{p} \in \left(\frac{(h-l)}{2}, \frac{Z+l}{2}(h-l)\right) \), only one bidder acquires. The seller’s revenue is \( m + p\left(Z + \frac{1}{2}(h + l)\right) - c_V\).

5. when \( \frac{c_V}{p} \in \left(Z + l + \frac{1}{2}(h-l), +\infty\right) \), no one acquires information. The seller’s revenue is \( m\).

Here, \( \bar{c} = \frac{p(h+l+2Z)}{2} - p\sqrt{(Z+l)(h+2l+3Z)} \).

Denote

\[
\mu = \frac{c_V}{p}
\]

as the cost of examining the existence of gains from trade, relative to the prior of the existence of gains from trade. This is the key variable that determines the level of entry in the bidding game. That is, if the cost of information acquisition is higher, or the prior of the existence of gains from trade is lower, then the entry will be lower. In addition, denote \( \mu^* (h-l) = \frac{(h-l)}{6} \), and \( \mu^{**} (h-l, Z+l) = Z + l + \frac{1}{2}(h-l) \), then Figure 3.1 summarizes the extent of entry (number of bidders informed of \( V \)) as a function of the relative cost \( \mu \).

**Intuition for Proposition 3.1 and Figure 3.1** When deciding whether to acquire information in a standard English auction, a bidder trades-off the cost of information acquisition \( c_V \) against the potential profit from the bidding game. The potential profit from the bidding game consists of two parts. The first part is the minimum level of gains from trade, \( p(Z + l) \). The second part consists of the information rent due to the uncertainty in the idiosyncratic part of the gains from trade, which is proportional to \( p(h - l) \). Therefore, how \( c_V \) is compared to \( p(Z + l) \) and \( p(h - l) \) will determine the level of entry. As \( c_V \) increases, there would be less information acquisition and hence less entry. Therefore, the mechanism
3.3 Seller’s Revenue in the Optimal Go-Shop Negotiation

From the discussion on an English ascending auction, we know that, when \( c_V \) is large, there could be insufficient information acquisition about the existence of gains from trade, and hence, there would be insufficient bidder participation. With a go-shop negotiation, however, we could potentially solve the problem by compensating one bidder to acquire information and revealing it to the other. In this way, both bidders learn the value of \( V \), and the seller achieves full entry.

Following this logic, we focus on go-shop negotiation mechanisms that implement equilibrium of the following form and optimize within this category:

- Bidder 1 acquires information about \( V \);
- Bidder 1 accepts the price floor \( b_1 \) if and only if \( V = Z \);
- The seller’s revenue is non-negative.

I denote this case as the go-shop negotiation fully revealing \( V \), in which bidder 1’s decision to accept the price floor \( b_1 \) fully reveals the value of \( V \). Later, I will show that the optimal go-shop negotiation that fully reveals \( V \) remains optimal if considering a more general set of the types of equilibrium to implement.
Before deriving the optimal go-shop negotiation step-by-step, it is helpful to discuss the key difficulties regarding implementing the equilibrium above, and how the optimal go-shop negotiation solves these issues.

First, the seller needs to incentivize bidder 1 to acquire information and provide information externality. There is a hold-up problem in addition to this free-riding problem. That is, because information acquisition is not directly contractable, the seller compensate bidder 1 conditional directly on bidder 1’s action of information acquisition. The solution is to compensation bidder 1 with termination fee $TF$, conditional on the first bid is high enough (higher than $b_1$). This is because a high willingness to pay already implies that the information has been acquired.

Second, the seller has to incentivize bidder 1 with $V = Z$ not to mimic $V = -Z$, because bidder 1 with $V = Z$ tries to hide the existence of gains from trade to avoid competition. The solution is to exclude bidder 1 if the first bid is too low (lower than $b_1$), and to compensate bidder 1 with a termination fee $TF$ if accepting to bid high enough (higher than $b_1$).

Finally, the seller needs to incentivize bidder 1 with $V = -Z$ not to mimic $V = Z$, because bidder 1 with $V = -Z$ tries to mimic $V = Z$ to get the termination fee $TF$. The solution in this case is to set the price floor $b_1$ to be high enough, so that bidder 2 with low values will be excluded. In this way, bidder 1 who discovers $V = -Z$ can no longer get the termination fee for free, because accepting the price floor implies a positive chance of winning the deal.

Now we will derive the optimal go-shop negotiation mechanism that fully reveals $V$.

3.3.1 Overview of the remaining part of Section 3.3

For the rest of Section 3.3 I will derive the optimal go-shop negotiation step-by-step. I first restrict attention to go-shop negotiations that implement equilibrium outcomes fully revealing $V$. I illustrate the equilibrium under the optimal go-shop negotiation within this category using Proposition 3.2. Then, to derive optimal go-shop negotiation illustrated in Proposition 3.2, I solve the problem backwards. That is, I first solve the continuation game in the second stage auction, while highlighting the potential inefficiency in the allocation rule in the second stage game. Then I go back to the first stage of go-shop negotiation, and set up the seller’s optimization problem. That is, I specify the seller’s objective function, as well as the individual rationality and incentive compatible constraints. Finally, I show that the optimal go-shop negotiation that implement equilibrium outcomes fully revealing $V$ remains to be optimal if allowing for
a more general set of the types of equilibrium outcomes as well.

3.3.2 Optimal go-shop negotiation fully revealing $V$

The following proposition describes the equilibrium induced by the optimal go-shop negotiation mechanism that fully reveals $V$.

**Proposition 3.2.** *(equilibrium under the optimal go-shop negotiations)*

Suppose $c_V \leq \min\{\frac{4}{3}p (1 - p) Z - \frac{53}{162} p (h - l), p(Z + l + \frac{31}{54} (h - l))\}$. Under the optimal $(b_1, TF, r_{B2})$, there exists an equilibrium in which

(i) Both bidders participate in the mechanism.

(ii) Bidder 1 acquires information about $V$, accepts the minimum bid if $V = Z$ regardless of $x_1$, and rejects otherwise. If accepting the price floor, bidder 1’s price at which to drop out of the English auction is

$$b_1 = \max(m + Z + x_1 - TF, b_1).$$

(iii) Bidder 2 learns $V$ from bidder 1’s action and therefore does not acquire information about $V$. Bidder 2 believes that $V = Z$ if bidder 1 accepts the price floor $b_1$. Bidder 2’s price at which to drop out is $m + \hat{V} + x_2$ in the English auction, where $\hat{V}$ is the value of $V$ learned from bidder 1’s action.

This proposition illustrates the essential strength of a go-shop negotiation over an English ascending auction. That is, by making both bidders informed of the existence of gains from trade, a go-shop negotiation improves entry.

However, the preferential treatment in a go-shop negotiation mechanism could potentially be a drawback. To see how the forces weigh against each other, I derive the proof of Proposition 3.2 and look for the exact form of the optimal $(b_1, TF, r_{B2})$.

Using backward induction, I solve the optimal go-shop negotiation mechanism that fully reveals $V$. Suppose that bidder 1 has acquired information. Let us consider the English auction at $t = 2$. The case with bidder 1 rejecting the price floor is straightforward. Bidder 1 is excluded from the trade, and bidder 2 also drops out of the game because $V = -Z$ is revealed. The lemma below derives the equilibrium

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17 Here is a proof of the lemma. In the English auction, bidder 1 makes the first bid $b_1$. If at $b_1 + TF$, bidder 2 decides to drop out, and bidder 1 therefore wins, paying $b_1$. If bidder 2 is able to top $b_1 + TF$, each bidder $i$ continues to top the opponent’s bid until their threshold of dropping out, $b_i$, has been reached. To prove the form of $b_1$ and $b_2$, we first consider bidder 1’s dominant strategy. We know that bidder 1 has committed not to drop out until $b_1$. Consider first bidder 1 with $x_1$
of the continuation game in the English auction at $t = 2$ if bidder 1 has learned $V = Z$, and has revealed that information to bidder 2 by accepting the price floor $b_1$.

**Lemma 3.1.** (bidding strategy at the second stage auction) Suppose bidder 1 has agreed to bid at least $b_1$ for all $x_1 \in [l, h]$ at $t = 1.5$, so that both bidders know $V = Z$ perfectly. In the second stage English auction, the seller has promised to pay $TF$ to bidder 1 if bidder 1 loses. The reserve price is $b_1$ for bidder 1, and is $b_1 + TF$ for bidder 2. Moreover, bidder 2 wins the auction if and only if his bid exceeds bidder 1’s by at least $TF$.

Then it is the weakly dominant strategy for bidder 1 and bidder 2 to drop out at

\[
    b_1 = \max (m + Z + x_1 - TF, b_1), \text{ and } \quad b_2 = m + Z + x_2
\]

respectively, where $Z + x_i, \forall i = 1, 2$ is the gains from trade between bidder $i$ and the target when $V = Z$.

In an English auction, the bidders drop out at the prices which equal to their net gain from winning the deal. For bidder 1, the valuation of the target if winning the auction, net of the gain if losing the deal, is $m + Z + x_1 - TF$. That is, bidder 1’s willingness to pay is reduced by the amount of the termination fee because bidder 1 loses $TF$ in case of winning. This makes bidder 1 a less aggressive bidder in this second stage auction than bidder 2, because bidder 2’s valuation, $m + Z + x_2$, is not affected by $TF$. The target mitigates such unfairness in the second stage auction by asking bidder 2’s bid to exceed bidder 1’s bid by at least $TF$ in order to win the deal.

The following lemma shows that as long as bidder 2 has not been excluded by the reserve price $b_1 + TF$, then the allocation rule in the second stage English auction is efficient, i.e., it assigns the target to the bidder with higher value.

**Lemma 3.2.** Suppose bidder 1 has agreed to bid at least $b_1$ for all $x_1 \in [l, h]$ at $t = 1.5$, so that both bidders know $V = Z$ perfectly.

such that $m + Z + x_1 - TF < b_1$, and suppose $b_2 < b_1 + TF$, i.e., bidder 2 drops out at the beginning of the auction. Then, bidder 1 is indifferent about dropping out at any $b_1 \geq b_1$, because bidder 1 always wins and pays $b_1$. Suppose $b_2 \geq b_1 + TF$. Then, bidder 1 drops out at $b_1$ because dropping out at any level strictly higher than $b_1$ weakly increases the chance of bidder 1 winning and the price to pay. Since $m + Z + x_1 - TF < TF$, winning and paying $b_1$ already gives bidder 1 negative profit, not to mention if the price to pay upon winning is higher than $b_1$. Therefore, to minimize loss, bidder 1 will not drop out at a level higher than $b_1$. Next, consider the case with $m + Z + x_1 - TF \geq b_1$. Then, similar to the standard argument with a typical English auction, dropping out at the net value of winning $m + Z + x_1 - TF$ is the dominant strategy for bidder 1. Therefore, $b_1 = \max (m + Z + x_1 - TF, b_1)$. Finally, we consider bidder 2’s dominant strategy to drop out. A similar argument as that in a standard English auction leads to the conclusion that $b_2 = m + Z + x_2$. 

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Consider the case where bidder 2’s bid \( m + Z + x_2 \) is higher than the reserve price for bidder 2, \( b_1 + TF \), so that such bidder 2 is not excluded from the second stage. Then bidder 2 wins the deal if and only if \( x_2 \geq x_1 \). That is, the allocation rule is efficient.

Therefore, when there is common knowledge of gains from trade \((V = Z)\), the allocation inefficiency in go-shop negotiation happens only when bidder 2 is excluded from the game by the reserve price \( b_1 + TF \). That is, when \( m + Z + x_2 < b_1 + TF \).

To highlight this allocation distortion, I define a new variable to isolate the force that excludes bidder 2 inefficiently. In particular, I define \( \Delta \) as

\[
\Delta = b_1 + TF - (m + Z + l). \tag{3.1}
\]

That is, if \( V = Z \) is revealed to both bidders, \( \Delta \) is the difference between the reserve price for bidder 2, \( b_1 + TF \), and bidder 2’s minimum price to drop out in the second-stage auction, \( \min (m + Z + x_2) = m + Z + l \). This term measures how difficult it is for bidder 2 to top the reserve price determined by the initial bid and the termination fee, or equivalently, how likely bidder 2 would be excluded from the game, because the probability of the first bid being topped \(^{18}\) is \( 1 - \frac{\Delta}{h-l} \).

The following proposition shows that the allocation rule is uniquely pinned down by \( \Delta \), while the termination fee \( TF \) only affects transfer when \( \Delta \) is fixed.

**Proposition 3.3.** (\( \Delta \) pins down allocation distortion, \( TF \) only affects transfer)\(^{19}\) Suppose both bidders learned that \( V = Z \).

(i) The target firm is inefficiently assigned to bidder 1 if and only if \( \Delta > 0 \). The expected efficiency loss from such distortion is \( p \left( \frac{\Delta}{n-1} \right)^2 \frac{l+\Delta}{b} \), which is increasing in \( \Delta \).

(ii) If fixing \( \Delta \), the termination fee \( TF \) is only a transfer from the seller to bidder 1 and does not create allocation distortion.

Now that we have derived the bidding strategy of both bidders in the second stage auction, we can go backward and derive the seller’s optimization problem.

\(^{18}\)Here is the proof for the argument according to (3.1).  \[
\Pr (b_2 > b_1 + TF) = \Pr (m + Z + x_2 > b_1 + TF) = \Pr (m + Z + x_2 > m + Z + l + \Delta) = \Pr (x_2 > l + \Delta) = 1 - \frac{\Delta}{h-l}.
\]

\(^{19}\)A higher \( \Delta \) while fixing \( TF \) also implies a lower transfer from the seller to the bidder 1, because \( b_1 \) is higher.
The seller’s problem is shown as below.

\[
\max_{\Delta, TF} \quad m + p \left[ \frac{(Z + l + \Delta - TF)}{\text{price floor } b_1} + \frac{(h - l - \Delta)^3}{3(h - l)^2} \right]
\]

\[\text{extra profit from competition}\]

\text{s.t.} \quad (a) \quad U_1 \geq n, \quad \text{(Bidder 1 participates in the game)}

\[U_1 \geq n + \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (-2Z (1-p) + x_1 - l - \Delta) \right] \}, \quad \text{(Bidder 1 acquires info)} \]

\[(b) \quad TF \geq \frac{\Delta^2}{h-l}, \quad \text{(Bidder 1 who learns } V = Z \text{ accepts } b_1, \forall x_1)\]

\[(c) \quad TF \leq \frac{\Delta}{h-l} (2Z - h + l + \Delta), \quad \text{(Bidder 1 who learns } V = -Z \text{ rejects } b_1)\]

\[(d) \quad TF \geq 0, \quad \text{(Assumption)}\]

\[(f) \quad 0 \leq \Delta \leq h - l, \quad \text{(a restriction that will be verified)} \quad (3.2)\]

where \(U_1\) is bidder 1’s ex ante expected profit of participating in the go-shop negotiation, with

\[U_1 = n - c_V + p \left[ TF + \frac{(h - l - \Delta)^3}{6(h-l)^2} + \frac{\Delta}{h-l} \left( \frac{l+h}{2} - l - \Delta \right) \right].\]

Let me explain the intuitions. The seller’s expected revenue from a go-shop negotiation consists of three parts: the target’s stand-alone value, the price floor promised by bidder 1 if there exists gains from trade, and the extra profit from the competition between the two bidders. Bidder 1’s ex ante expected profit of participating in the go-shop negotiation and conducting information acquisition consists of five parts: bidder 1’s outside option \(n\), the information acquisition cost \(c_V\), the termination fee \(TF\) promised by the seller, the profit \(\frac{(h - l - \Delta)^3}{6(h-l)^2}\) if \(x_1\) is high enough \((x_1 > l + \Delta)\), and the profit \(\frac{\Delta}{h-l} \left( \frac{l+h}{2} - l - \Delta \right)\) if \(x_1\) is low enough \((x_1 \leq l + \Delta)\).

To implement the equilibrium that fully reveals the value of \(V\), the go-shop negotiation has to satisfy the following conditions. Condition (a) requires that bidder 1’s ex ante expected profit of participating in the game should be at least as high as the outside option \(n\). Condition (b) requires that bidder 1 should find it profitable to acquire information after participating in the game. Condition (c) requires that the termination fee \(TF\) is high enough, so that bidder 1 who learns there exists gains from trade always accepts the price floor. Condition (d) requires that the termination fee \(TF\) cannot be too high, and the allocation distortion \(\Delta\) should be high enough (bidder 2 is excluded sufficiently often), so that bidder 1 who learns there is no gain from trade will not pretend there is and gets \(TF\) for free. Condition (e) is
directly from Assumption 4, and condition (f) is a restriction that will be verified later in the Appendices.

Note that Problem (3.2) does not say anything about the choice of \( r_{B2} \), which is the seller’s reserve price when bidder 1 is excluded from the game in the first stage. \( r_{B2} \) does not enter the seller’s revenue, because bidder 1 is excluded if and only if \( V = -Z \), in which case the target is not sold. \( r_{B2} \) does not affect bidder 1’s incentives either, because it is the seller’s reserve price to bidder 2 when bidder 1 has already been excluded from the game.

Actually any \( r_{B2} \geq m \) would be optimal for the seller, because bidder 2 always bid below \( m \) knowing there is no gains from trade. For simplicity, let the optimal \( r_{B2} = m + Z + l \).

Solving Problem (3.2) leads to the full characterization of the optimal go-shop negotiation mechanism fully revealing \( V \), as stated below.

**Proposition 3.4. (An optimal go-shop negotiation that fully reveals \( V \))**

Suppose \( \frac{c_V}{p} < \mu^{***} \), and restrict attention to go-shop negotiation mechanisms that induce equilibria in which bidder 1 acquires information and accepts the price floor if and only if \( V = Z \). Then, the optimal \((b_1, TF, r_{B2})\) within this category includes a price floor \( b_1 = m + Z + l + \Delta - TF \) and \( r_{B2} = m + Z + l \), where \((\Delta, TF)\) is characterized as follows:

(i) if \( \frac{c_V}{p} \in \left[\frac{h-l}{162/55}, \mu^{***}\right) \), then

\[
(\Delta, TF) = \left(\frac{2}{3} (h-l), \frac{17}{162} (h-l) + \frac{c_V}{p}\right).
\]

(ii) if \( \frac{c_V}{p} \in \left[\frac{h-l}{6}, \frac{h-l}{162/55}\right) \), then \( \Delta \in [0, \frac{2}{3} (h-l)) \) and is the unique solution for

\[
\frac{c_V}{p} = -\frac{\Delta^3 - (h-l)(h-l)^3 - 3\Delta^2 (h-l)}{6 (h-l)^2}
\]

and that it is strictly increasing in \( \mu = \frac{c_V}{p} \).

\( TF \) satisfies

\[
TF = \frac{\Delta^2}{h-l}.
\]

(iii) if \( \frac{c_V}{p} \in [0, \frac{h-l}{6}) \), then

\[
(\Delta, TF) = (0, 0).
\]

where \( \mu^{***} = \min\{\frac{4}{3} (1-p) Z - \frac{53}{162} (h-l), (Z + l + \frac{31}{54} (h-l))\} \), and \( \mu^{***} > \mu^{**} \).
Bidder 1 acquires info, and accepts price floor iff $V = Z$.
Bidder 2 learns $V$ from bidder 1.

Figure 3.2: Bidder Entry in Go-Shop Negotiations

Similar to Figure 3.1, Figure 3.2 summarizes the level of entry for bidders in go-shop negotiations according to Proposition 3.2 and Proposition 3.4. Comparison of the two figures show that go-shop negotiations create higher entry for a wide range of $\mu = \frac{cV}{p}$.

3.4 Go-shop negotiations implementing other types of equilibria

The optimal go-shop negotiation mechanism that implements equilibrium fully revealing $V$ remains to be optimal if I consider implementation of a more general set of equilibria. The generalization is that instead of requiring bidder 1 to accept the price floor if and only if $V = Z$, I require bidder 1 to accept $b_1$ only if $V = Z$. That is, if bidder 1 discovers that the idiosyncratic component $x_1$ is too low, then bidder 1 rejects the price floor.

**Proposition 3.5.** The optimal go-shop negotiation mechanism stated in Proposition 3.4 remains to be optimal if considering go-shop negotiations that implement the following types of outcomes: (i) bidder 1 acquires information, (ii) bidder 1 accepts the price floor $b_1$ only if $V = Z$, and (iii) seller’s revenue is non-negative.

Note that I still restrict attention to the case with bidder 1 acquiring information, and with bidder 1 rejecting the price floor if there are no gains from trade ($V = -Z$). The latter is intuitive. The former restriction is reasonable as long as the cost of information acquisition is not too large.
3.5 Revenue Comparison between a Go-Shop Negotiation and an English Ascending Auction

This section introduces the key result of the paper by comparing the seller’s revenue under the optimal go-shop negotiation mechanism and the optimal ascending auction mechanism.

**Proposition 3.6. (Revenue Comparison)**

Restrict attention to $c_V$ and $p$ such that $0 \leq \frac{c_V}{p} \leq \mu^{***}$.

(i) If $\frac{c_V}{p} > \frac{h-l}{6}$, i.e. if the information cost $c_V$ is high enough, or the prior of existence of gains from trade $p$ is low enough, then the seller’s revenue in the optimal go-shop negotiation mechanism is strictly higher than that in the optimal ascending auction.

(ii) If $\frac{c_V}{p} \leq \frac{h-l}{6}$, i.e. if the information cost $c_V$ is low enough, or the prior of existence of gains from trade $p$ is high enough, the optimal go-shop negotiation mechanism achieves the same revenue as in the optimal ascending auction.

**Remarks on Proposition 3.6** Proposition 3.6 is the key result in the benchmark model. The results are based on Assumption 1, which implies that the existence of gains from trade is perfectly correlated between the two bidders. That is, the gains from trade exist for one bidder if and only if they also exist for another bidder (in such case, $V = Z$). Therefore, Proposition 3.6 concludes that when the correlation between bidder valuations is sufficiently enough as in Assumption 1, then the optimal go-shop negotiation outperforms the optimal English auction when the cost of information acquisition $c_V$ is high enough, or when the bidders’ prior $p$ of the existence of gains from trade is low enough. Intuitively speaking, go-shop negotiations improve the seller’s revenue because they increase entry. Recall Figure 3.1 and 3.2 that show the level of entry in the two mechanisms as functions of the relative cost $\mu = \frac{c_V}{p}$. When $\mu$ is very small, both bidders acquire information in an English auction; hence, there is already full entry. Therefore, go-shop negotiations cannot improve the revenue. When $\mu$ is large enough but not unreasonably high, the go-shop negotiation induces full entry, while the English ascending auction induces at most partial entry, so the revenue from the go-shop negotiation is strictly higher.

Note that the value $\frac{h-l}{6}$ is the critical point where the go-shop negotiation starts to improve bidder participation relative to the English auction. This is because when $\mu < \frac{h-l}{6}$, the profit in the English auction is large enough for both bidders to be willing to pay the cost $c_V$, given the prior $p$ of the existence of gains from trade, while there is not sufficient bidder profits to induce full bidder participation if $\mu \geq \frac{h-l}{6}$.
Figure 3.3: Comparison between the Two Mechanisms: Seller Revenue and Bidder Participation

Figure 3.3 summarizes the key results of the revenue comparison.

### 3.5.1 The trade-offs between a go-shop negotiation and an English ascending auction

Now let’s examine the intuition of Proposition 3.6 in more details. Whenever the revenue in the optimal go-shop negotiation is higher than that of the optimal ascending auction, the difference can be decomposed into the forces in favor of and against go-shop negotiations as follows.

- **Benefits:**
  1. social surplus increases due to more entry;
  2. total rent of bidders decreases due to more competition when there is more entry; and
  3. $(\Delta, TF)$ as a rent-extracting device (reserve price and negative entry fee) further reduces the rent of bidders.

- **Costs:**
  1. the seller compensates bidder 1 for the information acquisition cost using $TF$; and
  2. distortion of allocation is caused by $\Delta > 0$.

Before investigating how these forces closely interact, a discussion on the role of $(\Delta, TF)$ is necessary.
3.5.2 The Transfer $TF$ and Distortion $\Delta$

The pair $(\Delta, TF)$ are costs of go-shop negotiations. However, the pair also provide a rent-extracting device. Therefore $(\Delta, TF)$ is a double-edged sword.

I start by analyzing the pair as a cost to the seller’s revenue. The proposition below shows that the two costs of go-shop negotiation are inevitable whenever the revenue of the optimal go-shop negotiation strictly dominates that of the optimal ascending auction.

**Proposition 3.7.** (i) $TF > 0$ and $\Delta > 0$, whenever the revenue of the optimal go-shop negotiation strictly dominates that of the optimal English ascending auction; and

(ii) $TF = 0$ and $\Delta = 0$, whenever the revenue of the optimal go-shop negotiation cannot improve on that of the optimal English ascending auction.

Recall Proposition 3.3 which shows that $TF$ is a transfer from the seller to bidder 1, and that any $\Delta > 0$ creates distortion. Then, part (i) of Proposition 3.7 implies that a strictly positive compensation from the seller to bidder 1 and a strictly positive distortion are both inevitable costs whenever go-shop negotiations outperform English ascending auctions. Part (ii) of Proposition 3.7 shows that both compensation and distortion become unnecessary when go-shop negotiations cannot increase entry compared to English ascending auctions, or equivalently, when go-shop negotiations can no longer generate higher seller’s revenue.

**Intuition of Proposition 3.7** When there is insufficient entry in an English ascending auction, it is also difficult to get bidder 1 to acquire information and to provide the informational externality to bidder 2 without any compensation from the seller in a go-shop negotiation. Therefore, the compensation $TF$ has to be strictly positive. As a result, the distortion $\Delta$ has to also be strictly positive. Otherwise, if $\Delta = 0$, bidder 1 who discovers that $V = -Z$ would pretend that the seller’s firm is worth buying by accepting the price floor $b_1 = m + Z + l - TF$. This is at no cost, because bidder 1 can always bid $b_1$ in the English ascending auction in the second stage. Bidder 1 loses for sure by bidding in this way, since bidder 2 believes that $V = Z$ after observing the acceptance and always bids above $b_1$.

However, the optimal $\Delta$ in Proposition 3.4 is actually higher than that which is required by the Incentive Compatible condition that bidder 1 with $V = -Z$ has to reject the price floor as shown in the lemma below. In fact, this is consistent with the observation that the termination fee is often higher than
the reimbursement of the information acquisition cost.

Therefore there must be other forces that push $\Delta$ further up beyond what is required by the incentive compatible condition, as stated in the Lemma below.

**Lemma 3.3.** The incentive compatible condition for $V = -Z$ to reject $b_1 = m + Z + l + \Delta - TF$ does not bind at the optimal $\Delta$ in Proposition 3.4.

To explore the question, we look at the seller’s revenue in Problem 3.2. Note that the seller’s revenue defined in Problem 3.2 is strictly increasing in $\Delta$ and strictly decreasing in $TF$. This is because higher $\Delta$ is similar to a higher reserve price, and higher $TF$ implies more transfer to bidder 1. In addition, bidder 1’s rent $U_1$ is strictly decreasing in $\Delta$ and strictly increasing in $TF$. Bidder 2’s rent is:

$$U_2 = n + \frac{(h - l - \Delta)^3}{6 (h - l)^2} + \frac{h - l - \Delta}{h - l} \frac{\Delta}{h - l} \frac{h - l - \Delta}{2},$$

which is strictly decreasing in $\Delta$ and does not depend on $TF$. Therefore, the seller may be able to extract both bidders’ rents by setting a high $\Delta$. This may come at a cost to bidder 1 who is no longer willing to accept a higher price floor, or who may even decide not to acquire information at all together. However, it is not a significant concern because the seller can increase $TF$ to compensate bidder 1 and avoid the problem.

The following numerical example shows that the similar magnitude of the allocation distortion and transfer observed in reality can be generated from the model under reasonable parameter choice.

**Example 3.1.** Target stand-alone value is $m = 30$, common part of the gains from trade

$$V = \begin{cases} 10, & \text{with probability 0.3,} \\ -10, & \text{with probability 0.7,} \end{cases}$$

idiosyncratic part $x_i \in U[1, 2], \ i = 1, 2$, cost of learning common part as % of target stand-alone value: $\frac{c_V}{m} = 1\%$. Then I show the values of the following variables for go-shop negotiations, including the expected winning bid premium, the first bid premium, the termination fee as fraction of the first bid, the probability of the first bid being topped, the probability of the second bidder winning conditional on the first bid being topped, and the unconditional probability of the second bidder winning the deal. I then

Table 3.1: Example 3.1

<table>
<thead>
<tr>
<th></th>
<th>Model</th>
<th>Data: deals attracting mostly financial buyers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected winning bid premium</td>
<td>35.24%</td>
<td>36.70%</td>
</tr>
<tr>
<td>First bid premium</td>
<td>35.19%</td>
<td>36%</td>
</tr>
<tr>
<td>Termination fee/First bid</td>
<td>2.7%</td>
<td>2.3%</td>
</tr>
<tr>
<td>% first bid being topped</td>
<td>33%</td>
<td>17%</td>
</tr>
<tr>
<td>% second wins cond. on first bid being topped</td>
<td>83%</td>
<td>71%</td>
</tr>
<tr>
<td>% second wins (lower if distortion is higher)</td>
<td>30%</td>
<td>12%</td>
</tr>
<tr>
<td>Seller revenue: go-shop negotiation</td>
<td>3.17</td>
<td>–</td>
</tr>
<tr>
<td>Seller revenue: auction</td>
<td>3.15</td>
<td>–</td>
</tr>
<tr>
<td>Go-shop minus auction</td>
<td>0.02</td>
<td>–</td>
</tr>
</tbody>
</table>

compare these values with their counterparts in deals attracting mostly financial buyers,\textsuperscript{22} where a go-shop negotiation is commonly used. As can be seen, the bid premia and termination fee as a fraction of the first bid are similar. In both the model and the data, the second stage competition exists. There also exists certain levels of allocation distortion in favor of the first bidder, in both the model and in reality, measured by the probability of a following bidder winning (model: 33%, reality: 17%). However, such a distortion is stronger in reality than that predicted in the model. Finally, I show the difference of seller’s revenue in the optimal go-shop negotiation and the optimal English ascending auction. The difference is small (go-shop - auction = 0.02) because I consider the asymmetric equilibrium in the English ascending auction. If I only allow for symmetric equilibrium in the English ascending auction, the seller’s revenue—net of stand-alone value in the English ascending auction—is 0, that is, \( \frac{g_{-\text{shop}} - \text{auction}}{g_{-\text{shop}}} = \frac{3.17 - 0}{3.17} = 100\% \).

\textbf{3.5.3 Decomposing the revenue difference between go-shop negotiations and English ascending auctions}

To further clarify the benefits and costs of a go-shop negotiation, I decompose the revenue difference between go-shop negotiations and the optimal English ascending auction into corresponding parts. Consider the region when \( c_V > \frac{p(h-l)}{6} \), such that the revenue of a go-shop negotiation is strictly higher than that of an English ascending auction. I will only illustrate the decomposition of seller’s revenue between a go-shop negotiation and an English ascending auction in the case with \( c_V \in (\bar{c}, \frac{p(h-l)}{2}] \), where \( r = Z + l \) and only one bidder acquires information. Decomposition in other cases is included in the Appendices.

\textsuperscript{22}Those are deals won by a financial buyer. Such deals are also attracting mostly financial buyers other than strategic buyers, according to Gorbenko and Malenko (2014). Source of data in this numerical example: MergerMetrics, 2003-2015.
The revenue of go-shop negotiations can be re-written in the form of social surplus subtracted by the rent of bidders:

\[
SR_{go-shop} = p \left[ Z + l + \frac{2}{3} (h - l) \right] - cV - p \left( \frac{\Delta}{h - l} \right)^2 \Delta \left( \frac{2}{3} - \frac{1}{2} \right) - \left( 0 \right)_{B1's \ rent} - p \left( \frac{(h - l - \Delta)^3}{6 (h - l)^2} + \frac{h - l - \Delta}{h - l} \right)_{B2's \ rent}
\]

\[
= p \left[ Z + l + \frac{2}{3} (h - l) \right] - cV - p \Delta^3 \left( \frac{6 (h - l)^2}{6 (h - l)^2} \right)_{social \ welfare \ without \ distortion}
\]

\[
- \left\{ \left[ \frac{h - l}{6} - cV + \frac{h - l}{6} \right] + cV - \left( \frac{3 \Delta^2 (h - l - \Delta) + (h - l)^3 + \Delta^3}{6 (h - l)^2} \right) \right\}_{total \ rent \ of \ bidders},
\]

where in the second equality, I decompose the total rent of bidders into the term \( p \frac{h - l}{6} - cV + p \frac{h - l}{6} \), plus the information acquisition cost \( cV \), net of an extra term \( p \frac{3 \Delta^2 (h - l - \Delta) + (h - l)^3 + \Delta^3}{6 (h - l)^2} \). The first term \( p \left( \frac{h - l}{6} - cV + \frac{h - l}{6} \right) = p \frac{h - l}{6} - cV + p \frac{h - l}{6} \) is the total rent of the two bidders in an English ascending auction, if bidder 1 has acquired information and announces it for free to bidder 2. Note that although this scenario never happens here, considering the bidders’ rent in this case is still helpful in order to separate the different forces at play. The second term implies that the target has to compensate bidder 1 for conducting costly information acquisition, and this compensation adds to the bidder’s total rent. The latter term \( p \frac{3 \Delta^2 (h - l - \Delta) + (h - l)^3 + \Delta^3}{6 (h - l)^2} \) is the extra amount of bidders’ rent the seller can extract by adjusting \((\Delta, TF)\). Note that the term is strictly increasing in \( \Delta \), consistent with the discussion in Section 3.5.2 about \((\Delta, TF)\) as a rent-extracting device.

In a similar fashion, the revenue of an English ascending auction can be rewritten as:

\[
SR_{auction} = p \left[ Z + l + \frac{1}{2} (h - l) \right] - cV - \left[ p \left[ Z + l + \frac{1}{2} (h - l) - r \right] - cV \right] - \left( 0 \right)_{Bidder \ 1's \ rent} - \left( 0 \right)_{Bidder \ 2's \ rent}
\]

\[
= p \left[ Z + l + \frac{1}{2} (h - l) \right] - cV - \left[ p \left[ Z + l + \frac{1}{2} (h - l) - Z - l \right] - cV \right] - \left( 0 \right)_{Bidder \ 1's \ rent} - \left( 0 \right)_{Bidder \ 2's \ rent}
\]

\[
= p \left[ Z + l + \frac{1}{2} (h - l) \right] - cV - \left[ p \frac{1}{2} (h - l) - cV \right] - \left( 0 \right)_{Bidder \ 1's \ rent} - \left( 0 \right)_{Bidder \ 2's \ rent}.
\]
Therefore, the difference in revenue of a go-shop negotiation and an English ascending auction is:

\[ SR_{go-shop} - SR_{auction} = \frac{2}{3} (h-l) - \frac{1}{2} (h-l) \]

\[ + \left[ \frac{h-l}{2} - c_V - \frac{h-l}{6} - c_V + \frac{h-l}{6} \right] \]

\[ + \frac{3 \Delta^2 (h-l - \Delta) + (h-l)^3 + \Delta^3}{6 (h-l)^2} \]

\[ - \frac{c_V}{\Delta^3} \]

\[ - \frac{p}{6 (h-l)^2} \]

where the first three positive terms correspond to the benefits, and the two negative terms correspond to the costs.

### 3.5.4 Welfare Analysis

The go-shop negotiation is more efficient than the English ascending auction.

**Proposition 3.8.** *(Social Welfare)*

When \( \frac{c_V}{p} < \frac{h-l}{6} \), the social welfare in a go-shop negotiation is higher because it saves the information acquisition cost.

When \( \frac{c_V}{p} \geq \frac{h-l}{6} \), the social welfare in a go-shop negotiation is higher because it improves entry.

### 4 Extensions

#### 4.1 Additional cost of a go-shop negotiation: requiring bidder 1’s rent to be no lower than bidder 2’s rent

The benchmark model assumes that the seller is able to implement the go-shop negotiation mechanism as long as both bidders’ profits in equilibrium are higher or equal to their outside option \( n \). In reality, however, if neither bidder is willing to take the lead and conduct information acquisition, the go-shop
negotiation mechanism cannot be implemented\textsuperscript{23} Therefore, in this section I impose a further constraint on the go-shop negotiation that the expected profit from being the first bidder has to be no lower than that of being the second. We will see that this additional requirement gives the go-shop negotiation mechanism a disadvantage. As a result, the go-shop negotiation is dominated by an English ascending auction when the information acquisition cost $c_V$ is low. This is complementary to the benchmark result in which the go-shop negotiation weakly dominates an English ascending auction in terms of seller’s revenue.

Similar to Proposition 3.4, we have the following proposition characterizing the optimal go-shop negotiation mechanism that fully reveals $V$.

**Proposition 4.1.** Suppose $\frac{p(h-l)}{6} < c_V < \min\{p\frac{50Z(1-p)-13(h-l)}{125/4}, p(Z + l + \frac{41}{75} (h - l))\}$, and restrict attention to go-shop negotiation mechanisms that induce equilibria, in which bidder 1 acquires information and accepts the price floor if and only if $V = Z$. Then the optimal $(h_1, TF, r_{B2})$ within this category includes a price floor $h_1 = m + Z + l + \Delta - TF$ and $r_{B2} = m + Z + l$, where $(\Delta, TF)$ is characterized as below:

(i) if $c_V \in \left[\frac{p(h-l)}{125/4}, \min\{p\frac{50Z(1-p)-13(h-l)}{125/4}, p(Z + l + \frac{41}{75} (h - l))\}\right]$, then:

$$(\Delta, TF) = \left(\frac{4}{5} (h-l), \frac{32}{125} (h-l) + \frac{c_v}{p}\right)$$

Also, $U_{1,FA} = U_{2,FA} \in (0, \frac{p(h-l)}{6})$.

(ii) if $c_V \in \left(\frac{p(h-l)}{6}, \frac{p(h-l)}{125/4}\right)$, then $\Delta \in (0, \frac{4}{5} (h-l))$ and is the unique solution for:

$$\frac{\Delta^3}{2 (h-l)^2} + \frac{c_v}{p} = \frac{\Delta^2}{h-l}$$

and it’s strictly increasing in $c_v$.

$TF$ satisfies

$$TF = \frac{\Delta^2}{h-l}$$

Also, $U_{1,FA} = U_{2,FA} \in (0, \frac{p(h-l)}{6})$.

When $c_V \in \left[0, \frac{p(h-l)}{6}\right]$, the optimal go-shop negotiation requires $\Delta < 0$ and $TF = 0$. That is, there would be no information revelation from the first bid, and no transfer from the seller to the first bidder.\textsuperscript{23}If both bidders are willing to take the lead, the seller can choose one by random, so this will not be a problem.
In this way, the optimal go-shop negotiation is the same as the optimal English ascending auction, in which both bidders acquire information.

Then we can compare the revenue in the optimal go-shop negotiation with that of the optimal English ascending auction in the following proposition. Proposition 4.2 implies that a go-shop negotiation dominates an English ascending auction when \( c_V \) is large enough, while it is dominated by an English ascending auction when \( c_V \) is small.

**Proposition 4.2.** There exists \( \mu \in \left( \frac{h-l}{6}, \bar{c}/p \right) \) where \( \bar{c} \) is defined in Proposition 3.1, such that:

(i) if \( \frac{c_V}{p} \in (\mu, \mu^{****}) \), the seller’s revenue in the optimal go-shop negotiation mechanism is strictly higher than that in the optimal English ascending auction;

(ii) if \( \frac{c_V}{p} \in \left( \frac{h-l}{6}, \mu \right) \), the seller’s revenue in the optimal go-shop negotiation mechanism is strictly lower than that in the optimal English ascending auction; and

(iii) if \( \frac{c_V}{p} \in [0, \frac{h-l}{6}] \), the seller’s revenue in the optimal go-shop negotiation mechanism equals to that in the optimal English ascending auction.

where \( \mu^{****} = \min \{ \frac{50Z(1-p)-13(h-l)}{125/4}, Z + l + \frac{41}{75} (h-l) \} \).

Figure 4.1 summarizes the result.

### 4.2 A model with continuous types and more natural assumptions

In the benchmark model with discrete types we find the following. Under the assumptions that first, the bidders’ values are correlated enough and second, the bidders’ prior of the existence of gains from trade is low enough, if the cost \( c_V \) to learn the existence of gains from trade is sufficiently high, the seller’s revenue in the optimal go-shop negotiation strictly dominates that of the optimal English ascending auction.
In this section, I first verify with numerical examples that the key results in the benchmark discrete type model still hold in a more elaborate model with normally distributed bidder values and more natural assumptions on information acquisition technology. Next, I will show with numerical examples that when the within-deal correlation of bidders’ values is smaller, a go-shop negotiation is dominated by an English ascending auction for a smaller range of parameters.

As in the benchmark model, bidders’ synergies are the sum of common part $V$ and idiosyncratic part $x_i$. That is:

$$ u_i = V + x_i $$

where $V \sim N(\mu_v, \sigma_v)$, $x_i \sim N(\mu_x, \sigma_x)$.

If invited by the seller to acquire information, bidder $i$ can either learn the precise value of $u_i$ by paying cost $c$, or a noisy version of $u_i$:

$$ s_i = u_i + \varepsilon_i, \quad \varepsilon_i \sim N(0, \sigma_\varepsilon) $$

Note that unlike the benchmark model, bidders’ signals are one-dimensional. That is, the bidder does not know the decomposition of the common and the idiosyncratic parts.

The model is not tractable analytically, thus I will work with numerical examples. Let the total variance of $u_i$ to be 1. That is, $\sigma_v^2 + \sigma_x^2 = 1$. The variance of noise without information acquisition relative to the total variance of $s_i$ is $\frac{\sigma_\varepsilon^2}{\sigma_v^2 + \sigma_x^2 + \sigma_\varepsilon^2} = \frac{1}{2}$. The expected gains from trade is $\mu_v + \mu_x = -0.5$, where the negative value suggests a pessimistic prior of the existence of gains from trade. The within-deal correlation of bidders, $\rho = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_x^2}$, can take two values: 0.9 and 0.5.

Figure 4.2 shows the seller’s revenue in go-shop negotiations and the optimal English ascending auction as functions of the information acquisition cost $c$, for the case of $\rho = 0.9$ and $\rho = 0.5$. Similar to the benchmark model, a go-shop negotiation generates a higher profit than an English ascending auction when the information acquisition cost $c$ is high enough; in addition, a go-shop negotiation loses its advantage when $c$ is low. As in the benchmark model, this is because when $c$ is high, there is less entry in an English ascending auction than in a go-shop negotiation, while when $c$ is low, a go-shop negotiation can no longer improve entry relative to an English ascending auction.

However, certain aspects of the equilibrium in the optimal go-shop negotiation here are slightly different from those in the benchmark model, due to different settings about information structure and
information acquisition technology. As in the benchmark model, a go-shop negotiation increases entry by inducing bidder 1 to acquire information and revealing bidder 1’s decision on whether or not to accept the price floor $b_1$. However, bidder 2’s information acquisition decision differs from the benchmark. In the benchmark model, bidder 2 acquires the information about the idiosyncratic part of gains from trade $x_2$ at no cost after learning about the existence of gains from the first trade. In the current version, however, obtaining information about the idiosyncratic part of gains from trade for bidder 2 is costly. That is, it is conducted through paying the cost $c$ and learning $u_i$. In equilibrium, if bidder 1 accepts the price floor, bidder 2 is encouraged to acquire information because bidder 2 is more confident about the existence of gains from trade; if bidder 1 rejects the price floor, bidder 2 is discouraged from information acquisition because of a more pessimistic view on the existence of gains from trade. Note that a key feature of such equilibrium in go-shop negotiations is that it induces a bifurcated incentive for bidder 2 to acquire information (i.e. more (less) incentive when bidder 1 accepts (rejects) the price floor). This will increase entry when $c$ is so high that only one bidder acquires information in the optimal English ascending auction, hence improving revenue in that case. However, this will decrease entry when $c$ is so low that both bidders acquire information in an English ascending auction. Therefore, the go-shop negotiation is dominated by the English ascending auction in terms of the seller’s revenue in the latter case, while the relation reverses in the former case, as shown in Figure 4.2.

This problem is similar to the problem of information cascade, because the second bidder does not use the information of his own valuations. That is, discouraged by the initial bid which reveals a low valuation by the initial bidder, the second bidder gives up learning his own valuation, although it might be possible that there exists gains from trade with the second bidder due to the imperfect correlation between the bidders’ valuations. However, this problem would be alleviated when the bidder valuations are higher, as shown in Figure 4.2.

Although this extension differs from the benchmark models in certain aspects, what is shared by the two model is that bidder 1’s acceptance reveals that it is more likely there that exist gains from trade. Encouraged by this information, bidder 2 has more incentive to acquire information about the idiosyncratic part of gains from trade so as to compete with bidder 1. Therefore, entry is improved when it is more likely that there exist gains from trade. It is this common intuition that generates similar

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24 Actually, the problem should be most salient where the correlation is neither too high nor too low, because when the correlation is too low, the second bidder won’t be discouraged by the low initial bid at all.
results on a go-shop negotiation compared to an English ascending auction in terms of seller’s revenue when the information cost varies.

We have seen that the qualitative results in the benchmark model are still robust within the current model. In addition, the comparison between the two figures in Figure 4.2 shows that the region where a go-shop negotiation dominates an English ascending auction shrinks when the intra-deal bidder value correlation \(\rho = \frac{\sigma^2_V}{\sigma^2_V + \sigma^2_i}\) is smaller. That is, a go-shop negotiation is less likely to occur when the intra-deal bidder value correlation is lower, which is a testable empirical prediction.

**Empirical Implication:** In deals with higher intra-deal correlation of bidder valuations, it is more likely that go-shop negotiations are used relative to traditional ascending auctions.
The rest of the extensions are all based on the benchmark discrete type model. I will focus on go-shop negotiations fully revealing $V$, because this simple mechanism has already captured the important forces at play.

### 4.3 When the correlation of bidder valuations is too large

In the benchmark model and in Section 4.2, I show that in order for a go-shop negotiation to outperform an ascending auction, the correlation of bidder valuations should be sufficiently high. Put it in a different way, the variation of the common component of gains from trade should be sufficiently high relative to that of the idiosyncratic component. However, in this section, we will show that the correlation cannot be too high. Or else, the second stage of a go-shop negotiation would be similar to a Bertrand competition, in which both bidders expect very low profits. If there is a bidding cost for the second bidder, the second bidder will not enter the game even knowing there exist gains from trade with the target.

To illustrate this idea, we deviate from the benchmark model by imposing a small logistic bidding cost $c_b$. That is, if invited to acquire information, each bidder $i$ has two options:

1. If paying a cost $c_V$, bidder $i$ learns $(V, x_i)$ and is also be allowed to bid, OR

2. If paying $c_x < c_V$, bidder $i$ cannot conduct due diligence, but is allowed to bid.

Suppose we fix the variation of the common part, $Z$, and vary the variation of the idiosyncratic part, $h - l$. When $h - l$ is reduced, the correlation of bidder valuations increases.

Part (i) of the following proposition shows that if the variation of the idiosyncratic component (as represented by $h - l$) is too low compared to the bidding cost $c_x$, then a go-shop negotiation with second stage competition is not implementable. Instead, the seller implements a no-shop negotiation, in which the termination fee precludes the second bidder from entering the game. In this case, the seller’s revenue in the same in the optimal ascending auction and the optimal go-shop negotiation. The results in Part (ii) and (iii) are the same as the benchmark case.

**Proposition 4.3.** Suppose $c_V < p(Z + l)$, and $c_x < \frac{1}{5p} c_V$. For go-shop negotiations, restrict attention to mechanisms that induce equilibria in which bidder 1 acquires information, and accepts the price floor if and only if $V = Z$. Then

---

The key results hold if assuming the initial bidder also bears such bidding cost.
(i) If \( h - l \in [0, \frac{162cV}{5p}] \), then the seller cannot implement any go-shop negotiations with second stage competition. Instead, the seller implements a “no-shop” negotiation in which the second bidder does not pay the cost to enter the game. The seller’s revenue is the same in the optimal no-shop negotiation and in the optimal English auction.

(ii) If \( h - l \in (\frac{162cV}{5p}, \frac{6cV}{p}] \), then the seller’s revenue in the optimal go-shop negotiation is strictly than that in the optimal English auction. In the optimal go-shop negotiation, bidder 2 participates the game, and tops \( b_1 \) with probability higher or equal to \( \frac{1}{3} \).

(iii) If \( h - l \in [\frac{6cV}{p}, \bar{h}) \), then the seller’s revenue in the optimal go-shop negotiation is the same to that in the optimal English auction. In the optimal go-shop negotiation, bidder 2 participates the game, and tops \( b_1 \) with probability 1.

Here \( \bar{h} = \min\{\left(\frac{4}{3}p (1 - p) Z - cV\right)^{\frac{162}{53p}}, Z (1 - 2p) - l\} \).

4.4 Compare a go-shop negotiation to the case with the seller conducting information acquisition and announcing it for free

To understand the go-shop negotiation mechanism better, we compare it with another mechanism that can also improve entry but does not create any distortion. Suppose that the seller can conduct the information acquisition herself by paying \( cV \), e.g. by hiring KPMG to do so. Then the seller announces the result \( V \) for free, effectively eliminating the entry cost by both bidders. If the seller does that, the optimal mechanism following the announcement is a standard English ascending auction with reserve price \( Z + l \), according to standard optimal mechanism design argument with independent valuations and no entry cost. The proposition below shows that the seller’s revenue in this case is still lower than that in the optimal go-shop negotiation.

**Proposition 4.4.** The seller’s revenue is lower than the optimal go-shop negotiation mechanism if the seller conducts information acquisition and announces it to the bidders for free.

The reason is that go-shop negotiation has a rent-extracting device that allows the seller to extract additional rents from the bidders. In particular, it is a combination of a negative entry fee to bidder 1 (positive termination fee \( TF \)), and a reserve price for bidder 2 (initial bid plus termination fee). If the seller conducts due diligence and announces it for free before an English auction, the seller does not have
this rent-extracting device.

4.5 Selling mechanism as a result of negotiation between the seller and the first bidder

Suppose if bidder $i$ walks away from this deal, then the outside option is $n + U$, where $n$ is both bidders’ stand-alone firm value, and $U \geq 0$ is both bidders’ profit in addition to $n$ if moving on from this deal to other potential deals. Note that $n$ is fundamentally different from $U$, because the bidders’ stand-alone value $n$ will remain in the merged firm, while $U$ will disappear after merger:

- bidder 1 arrives, and negotiate with the seller on $(b_1, TF, r_{B2})$:
  - Nash bargaining; and
  - outside option if the negotiations on $(b_1, TF, r_{B2})$ breaks down: an auction would be held after the seller has contacted bidder 2 to see if bidder 2 is a potential bidder;

- time-line of an English ascending auction and a go-shop negotiation:
  - remains the same as in the benchmark, except that the probability of bidder 2 not being a potential bidder is $\rho \in [0, 1]$. In a go-shop negotiation, whether or not bidder 1 is a potential bidder is revealed only after bidder 1 has accepted or rejected the price floor $b_1$.

Proposition 4.5. When $U < U_0$, the same results hold as for the benchmark model. Otherwise, a go-shop negotiation in which bidder 2 participates does not exist. The seller instead implements a no-shop negotiation in which only bidder 1 participates. The revenue is the same as in the English ascending auction in this case.

This proposition implies that if a bidder’s bargaining power is low (e.g. there are more potential bidders), a go-shop negotiation could outperform an English ascending auction. If otherwise, a go-shop negotiation would rarely be used. If used, the second stage competition is very limited. Also, a no-shop negotiation in which the target cannot shop for further bids after negotiation would be common.

\footnote{The reason why the seller cannot sell this information to the bidders is that typically in the sales of corporations, the seller cannot extract a strictly positive entry fee due to the concern by the bidders that this deal might be a scam. Put it in another way, a loser cannot pay.}
4.6 Seller cannot set a reserve price in the standard English auction

If we deviate from the benchmark model by assuming that the seller cannot set a reserve price in the English ascending auction, then the advantage of go-shop negotiations compared to English ascending auction is even stronger. This is because the tentative agreement specifying a minimum bid in the intermediate stage allows the seller to commit to a reserve price in a go-shop negotiation.

**Proposition 4.6.** If the seller cannot set a reserve price unless with the first bid in a go-shop negotiation, then the difference in the seller’s revenue between a go-shop negotiation and an English ascending auction is even larger than in the benchmark case.
5 Empirical Results

I study MergerMetrics provided by FactSet. The time range is from 2003 to 2015, with only deals with a US public target being used. Also, I consider deals completed or deals withdrawn due to a competing bid.

I use the following two filters provided by MergerMetrics, the definitions of which are as follows.

Definition 5.1. (Auction/Negotiation and Go-shop/No-shop)

(i) “Auction”: Yes if the deal starts with the seller hiring an investment bank to solicit all potential bids. Deal defined as a “Negotiation” otherwise; and

(ii) “Go-shop Provision”: Yes, if the merger agreement allows the seller to actively solicit bids after the agreement is signed. “No-shop” defined as the seller not being permitted to do so.

Using the filters “Auction” and “Go-shop Provision” provided by MergerMetrics, I categorize all the deals into four groups:

- Negotiation & Go-shop (go-shop negotiations);
- Auction & No-shop (standard auctions);
- Negotiation & No-shop (no-shop negotiations); and
- Auction & Go-shop.

My model has covered the first three mechanisms, which constitute the majority of all mechanisms in use. In particular, the no-shop negotiation mechanism corresponds to a go-shop negotiation with a high termination fee, so that no new bidders would participate.

5.1 Higher correlation of bidders’ values on the target’s firm leads to more frequent use of go-shop negotiations

The model implies that in deals where the correlation of bidders’ values for the target’s firm is large enough, we will see more use of go-shop negotiations relative to standard English ascending auctions.

The within-deal correlation of bidders’ values corresponds to:

\[ \rho = \frac{\text{Var}(V)}{\text{Var}(V) + \text{Var}(x_i)} \]
in my model. Because valuations are not directly observable, I measure the intra-deal correlation among bidders’ values by the intra-deal correlation of a bid premium\(^{27}\). In particular, I define:

\[
\text{bid premium} = \frac{\text{bid}}{\text{target stock price 1 day before press release of intention to sell}}
\]

Note that I normalize the bid by the target stock price.

I use the hand-collected data in Gorbenko and Malenko (2014), provided by the authors. With a Random Effect ANOVA (Analysis of Variance) model, I estimate the within-deal correlation of bid premia.

Figure 5.1 illustrates the relationship between the intra-deal correlation of bid premia and the use of go-shop negotiations, both relative to all mechanisms and relative to the use of standard English ascending auctions. The relation is consistent with the predictions of the model.

To be specific, I show that the within-deal correlation of bid premia is higher for deals won by a financial buyer than that of deals won by a strategic buyer. In particular, the correlation for deals won by a financial buyer is 0.96, which is higher than that of strategic deals (0.81), even if taking into account the 90% confidence interval.

The intuition for this result is as follows. According to Gorbenko and Malenko (2014), in the deals won by financial (strategic), the majority of bidders are financial (strategic). In particular, Table I of Gorbenko and Malenko (2014) shows that for a deal won by a financial bidder, there are seven financial bidders and two strategic bidders on average; for a deal won by a strategic bidder, there is one financial bidder and three strategic bidders on average. Moreover, the business models of financial buyers are very similar, hence their potential synergies with the target are also highly correlated\(^{28}\). Then, the average within-deal bidder value correlation is higher for deals won by a financial buyer, because such deals mainly attract financial buyers with very similar business models.

In addition, the within-deal correlation of the bid premium is higher for deals with targets being in industries such as Consumer Durables, Non-Durables, and Retail Trade, compared to that of deals when the targets are in the industries of High-Tech. In particular, the correlation if the target industry is in Consumer Durables, Non-Durables and Retail Trade is 0.96, which is higher than that of High-Tech (0.92),

\(^{27}\)Bids should be highly correlated with values in most auction models. A precise measure of intra-deal correlation of bidder values will involve structural estimation, which is outside the scope of this paper.

\(^{28}\)See Gorbenko and Malenko (2014), Leslie and Oyer (2008)
although the difference is less statistically significant compared to the case with financial vs. strategic buyers. Intuitively, targets in High-Tech industries have more growth options, implying many possibilities for the firm’s future business models and a variety of patterns for potential synergies. Therefore, bidders’ values are less correlated in those deals.

As predicted by the theoretical results, the ratio of the frequency of use of go-shop negotiations relative to that of standard English ascending auctions is indeed higher in deals with higher intra-deal correlation of bid premia. That is, it is higher in deals attracting mostly financial buyers compared to strategic buyers, and is also higher if target industry is Consumer Durables, Non-Durables and Retail trade compared to High-Tech.

5.2 Allocation Distortion

The model further implies that the probability of both the new bidder topping the initial bid and the new bidder winning the game should be sufficiently high, although there exists allocation inefficiency in favor of the first bidder at optimum. As expected, empirical evidence implies that the probability of the first bid being topped is not low in cases with more frequent use of go-shop negotiations is not low (17% for deals attracting mostly financial buyers, 33% when target industries are in Consumer Durables, Non-Durables and Retail trade). The probability of the new bidder winning is 12% for deals attracting mostly financial buyers, and 21% when target industries are in Consumer Durables, Non-Durables and Retail trade, indicating potential allocation inefficiency.

Figure 5.2 shows the magnitude of the probability of the initial bid being topped, the probability of the new bidder winning conditional on the first bid being topped, and the unconditional probability of the new bidder winning, if a go-shop negotiation is used.

5.3 Alternative Hypothesis: strong bargaining power for bidders

An alternative hypothesis states that the seller chooses a go-shop negotiation over an English ascending auction because the seller is forced to do so by the first bidder who has strong bargaining power. This implies that in markets where bidders’ bargaining powers are strong, there would be more use of a go-shop negotiation. On the contrary, the theoretical results here show that in markets where the bidders’ bargaining power is too strong, it is difficult to implement a go-shop negotiation mechanism in which the following bidder enters the second stage game. Instead, the seller chooses to implement no-shop
Figure 5.1: Intra-Deal of Bid Premium and the Use of Go-Shop Negotiations

(a) Financial vs. Strategic

(b) By Target Industry
The empirical evidence seems to favor the results of this paper. Indeed, I find that when there are less potential bidders\footnote{The average number of bidders are also provided by the authors of Gorbenko and Malenko (2014).} (in deals attracting mostly strategic buyers (11 bidders) compared to financial (24 bidders), and in deals with target industry being High-Tech (16 bidders) compared to Consumer Durables, Non-Durables and Retail trade (25 bidders)), the use of a go-shop negotiation is lower. In addition, the use of no-shop negotiation is higher, in which the termination fee is high and the target cannot actively solicit bids after negotiation with the first bidder. Figure 5.3 illustrates this result.

5.4 Alternative Hypothesis: agency issue

Another alternative hypothesis for the use of a go-shop negotiation is the agency issue. In particular, the target may choose a go-shop negotiation in order to favor one bidder, because the target’s management enjoys certain private benefits if that bidder wins.

Empirical evidence suggests that the agency issue does indeed exist. First, a financial buyer is less
Figure 5.3: Alternative Hypothesis: Strong Bidder Bargaining Power

(a) Financial vs. Strategic

(b) By Target Industry
likely to replace the former management of the target firm than a strategic buyer. Indeed, anecdotal evidence suggests that 69% of target management will be replaced during the holding period of a private equity buyer\textsuperscript{30} which is lower than that of a strategic buyer (95%)\textsuperscript{31} Therefore, it is possible that agency issue is stronger with a financial buyer, and this is partially the reason why a go-shop negotiation is used more often when the buyer is financial.

To further study the agency issue, I look at Management-Led Buyout (MBO) deals where the agency issue is potentially salient. MBO deals are deals led by the management team, usually sponsored by a private equity buyer. They consist 9% of all deals, and 8% of deals using a go-shop negotiation. The use of go-shop negotiations is indeed more frequent than that of a Non-MBO case (MBO: 21%, Non-MBO (5%). However, the probability of the following bidder winning conditional on the the first bid being topped is much lower than that of a Non-MBO case (MBO: 33%, Non-MBO: 71%), although the difference is not statistically significant due to the small sample size of MBO deals (see Figure 5.4). This is most likely because the first bid does not reveal all the information known by the first bidder who is supported by the management, so the following bidders shade their bids because of the concern of “winner’s curse”.

We can also analyze the agency issue by looking at the deals in which a post-merger CEO, Chairman or President is originally from the target firm, within deals won by a strategic buyer\textsuperscript{32} These deals consist of 9% of all deals won by strategic buyers. In particular, the use of go-shop negotiations (2%) is similar to that of all deals won by a strategic buyer (3%)\textsuperscript{33} The use of no-shop negotiation is much higher in these deals (89% vs. 63% in all deals won by strategic deals). Therefore, for strategic deals that are susceptible to the agency issue, the first bidder and the target management often use no-shop negotiations instead of go-shop negotiations.

To conclude the agency issue, empirical evidence suggests the possibility of such a problem in MBO deals. However, the agency issue is unlikely to be the entire story, as MBO deals consist of only 8% of deals using go-shop negotiations.

\textsuperscript{30}See http://blogs.wsj.com/atwork/2014/04/25/fact-check-does-private-equity-kill-jobs/?cb=logged0.016885896682828916
\textsuperscript{31}Source of data: MergerMetrics, 2003-2015. The data for financial buyer about post-merger management is not available in MergerMetrics.
\textsuperscript{32}The post-merger management data for deals won by a financial buyer is not available.
\textsuperscript{33}The use of go-shop negotiations over the sum of go-shop negotiations and standard auctions is higher (18% in these deals vs. 8% in all deals won by strategic deals).
Figure 5.4: Alternative Hypothesis: Agency Issue

5.5 The bankruptcy sale under Section 363 of Chapter 11

The model shows that a go-shop negotiation is more likely to be used when the prior of the existence of gains from trade is low. This is consistent with a go-shop negotiation being a major mechanism in bankruptcy sales (84% according to Gilson, Hotchkiss and Osborn (2015)) while it is only 5% in non-bankruptcy mergers and acquisitions. There is also significant second stage competition. The probability of the first bid being topped is 55%, the probability of a new bidder winning the deal conditional on first bid is topped is 54%, and the unconditional probability of a new bidder winning is 30%.

6 Conclusion

This paper shows that the seller prefers go-shop negotiations over standard English ascending auctions when the following conditions are met. First, correlation of the bidders’ value on the seller’s firm is sufficiently large (but not too highly correlated), second, the cost of information acquisition is large, third, the prior of the existence of gains from trade is pessimistic, and finally, the bidders’ bargaining power is not too large. The empirical evidence in M&A suggests that the use of a go-shop negotiation could be driven by seller revenue maximization and it provides an explanation for the prevalence of go-shop

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\[\text{In particular, the bankruptcy sales refer to the sales of all assets under Section 363 of Chapter 11.}\]
management in deals attracting mostly private equity buyers.
References


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APPENDICES

A  English Auction (Ascending Auction)

Proof of Proposition 3.1

To make the proof more succinct, I normalize $m = n = 0$. All results remain unchanged if this assumption is relaxed, except that $m$ is added to all reserve prices to seller’s revenue, and that $n$ is added to bidders’ profit.

We consider Bayesian Nash Equilibrium with weakly dominant bidding strategy. The information acquisition strategy could be either pure or mixed.

First of all, there is no point for the seller to set $r > Z + h$, since there would be no sale as a result. Therefore we only consider the case with $0 \leq r \leq Z + h$.

Lemma A.1. In any Bayesian Equilibrium with weakly dominant bidding strategy, a bidder bids below 0 if he does not acquire information.

Proof. The bidder bids below 0 if his probability that $V = Z$ conditional on winning is equal to or lower than the prior. A sufficient condition for that is that the uninformed bidder is equally or more likely to win when $V = -Z$ compared to when $V = Z$. This is indeed true. Suppose the bidder’s opponent is also uninformed. Then whether the bidder wins is independent of the realization of $V$, hence the bidder is equally likely to win in both cases. If the bidder’s opponent has acquired information, then if $V = -Z$ the informed opponent bidder will bid below zero so the bidder wins with probability 1 if bidding above the reserve price; if $V = Z$, the probability of the bidder winning by bidding above the reserve price is smaller or equal to 1. Therefore if the opponent is informed, the the bidder is weakly more likely to win when $V = -Z$ compared to when $V = Z$ due to winner’s curse, hence the probability that $V = Z$ conditional on winning is no higher than the prior, hence uninformed bidder bids below 0. □
Mixed strategy equilibrium with $Z + h \geq r \geq Z + l$.

Suppose bidder $i$'s opponent’s probability of acquiring is $q$, then the payoff to bidder $i$ if acquiring information and if $Z + h \geq r \geq Z + l$ is

$$
qp \int_{r-Z}^{h} \frac{1}{h-l} \left( x_i + Z - \frac{(x_i + Z + r)}{2} \right) + \frac{r - Z - l}{h-l} \cdot (x_i + Z - r) dx_i 
+ (1 - q) p \int_{r-Z}^{h} \frac{x_i + Z - r}{h-l} dx_i 
- c_V
$$

Letting the payoff be zero (the payoff of not acquiring according to Lemma [A.1], and solving for $q$, we find the unique mixing probability. The probability is identical across the two symmetric bidders.

$$
q_{ml} = \frac{3 \left( h - l \right) \left( -2c_V (h - l) + q (h + Z - r)^2 \right)}{2p (h + Z - r)^3}
$$

This mixing probability $q_{ml}$ is decreasing in $c_V$:

$$
\frac{\partial q_{ml}}{\partial c_V} = -\frac{3 \left( h - l \right)^2}{p (h + Z - r)^3} < 0
$$

It’s also decreasing in $r$ on $[Z + l, Z + h]$ as long as the probability $q_{m1} \leq 1$. $q_{m1} \leq 1$ is equivalent to

$$
\frac{3 \left( h - l \right) \left( -2c_V (h - l) + p (h + Z - r)^2 \right)}{2p (h + Z - r)^3} \leq 1
\Leftrightarrow -3 \left( h - l \right) \left( 2c_V (h - l) - p (h + Z - r)^2 \right) \leq 2p (h + Z - r)^3
\Leftrightarrow - \left( h - l \right) \left( 6c_V (h - l) - 3p (h + Z - r)^2 \right) \leq 2p (h + Z - r)^3
\Leftrightarrow 6c_V (h - l) - p (h + Z - r)^2 \geq 2p (h + Z - r)^2 - \frac{2p (h + Z - r)^3}{(h - l)}
\Leftrightarrow 6c_V (h - l) - p (h + Z - r)^2 \geq 2p (h + Z - r)^2 \left( 1 - \frac{h + Z - r}{h - l} \right)
\Leftrightarrow 6c_V (h - l) - p (h + Z - r)^2 \geq 2p (h + Z - r)^2 \frac{r - l - Z}{h - l}
$$

Since $r \geq Z + l$, the last inequality implies that

$$
6c_V (h - l) - p (h + Z - r)^2 \geq 2p (h + Z - r)^2 \frac{r - l - Z}{h - l} \geq 0
$$
Then

\[ \frac{\partial q_{m1}}{\partial r} = \frac{-3 (h - l) \left(6cV (h - l) - p(h + Z - r)^2 \right)}{2p(h + Z - r)^4} \leq 0 \]

To further pin down the shape of \( q_{m1} \) as a function of \( r \) on \([Z + l, Z + h] \), we look at the following conditions.

\[ q_{m1}|_{r=Z+l} > 1 \]
\[ \iff \frac{3}{2} - \frac{3cV}{p(h - l)} > 1 \]
\[ \iff cV < \frac{p(h - l)}{6} \]

\[ \frac{\partial q_{m1}}{\partial r}|_{r=Z+l} > 0 \]
\[ \iff \frac{3 (-6cV + p(h - l))}{2p(h - l)^2} > 0 \]
\[ \iff cV < \frac{p(h - l)}{6} \]

Also, \( \frac{\partial q_{m1}}{\partial r} = 0 \) has a unique solution in \(( -\infty, Z + h) \), which is \( r = Z + h - \sqrt{\frac{6cV(h-l)}{p}} \). The solution lies in \(( Z + l, Z + h) \) if and only if

\[ Z + h - \sqrt{\frac{6cV(h-l)}{p}} > Z + l \]
\[ \iff h - l > \sqrt{\frac{6cV(h-l)}{p}} \]
\[ \iff cV < \frac{p(h - l)}{6} \]

while the solution is below \( Z + l \) if \( cV \geq \frac{p(h-l)}{6} \).

Finally, \( q_{m1} = 0 \) has a unique solution in \(( -\infty, Z + h) \), which is \( r = Z + h - \sqrt{\frac{2cV(h-l)}{p}} \). The solution
Lemma A.2. \((1)\) when \(c_V \in (0, \frac{p(h-l)}{6})\), \(q_{m1} \geq 1\) on \(r = Z + l\). Then as \(r\) increases, \(q_{m1}\) first increases above \(1\), and then decreases and crosses \(1\) from above at \(r = r_1(c_V)\), where \(r_1(c_V)\) is the unique solution for \(\frac{dr_1(c_V)}{dc_V} = \frac{(h-l)^2}{p(Z+h-r_1(c_V))(Z+l-r_1(c_V))} < 0\), \(r_1 \left(\frac{p(h-l)}{6}\right) = Z + l\) and \(r_1(c_V) \in [Z + l, Z + h]\). In addition, \(\lim_{c_V \to 0} r_1(c_V) = 1\). Then it hits \(0\) at \(r_0(c_V) = Z + h - \sqrt{\frac{2c_V(h-l)}{p}}\) before \(r\) reaches \(Z + h\). So \(q_{m1} \in (0,1)\) and mixed-strategy equilibrium exists if and only if \(r \in (r_1(c_V), r_0(c_V))\).

\((2)\) when \(c_V \in \left(\frac{p(h-l)}{6}, \frac{p(h-l)}{2}\right)\), \(q_{m1} < 1\) on \(r = Z + l\). Then as \(r\) increases, \(q_{m1}\) decreases, hitting \(0\) at \(r_0(c_V) = Z + h - \sqrt{\frac{2c_V(h-l)}{p}}\) before \(r\) reaches \(Z + h\). So \(q_{m1} \in (0,1)\) and mixed-strategy equilibrium exists if and only if \(r \in [Z + l, r_0(c_V)]\).

\((3)\) when \(c_V \in \left[\frac{p(h-l)}{2}, +\infty\right)\), \(q_{m1} < 0\) on \(r = Z + l\). Then as \(r\) increases, \(q_{m1}\) decreases, remaining below \(0\). So \(q_{m1} \notin (0,1)\) and no mixed-strategy equilibrium exists.

Lemma A.3. The seller’s profit in a mixed-strategy acquisition equilibrium with \(r \in [Z + l, Z + h]\) is

\[
SR_{m1} = pq_{m1}^2 \left[ r \cdot 2 \cdot \frac{(Z + h - r)(r - Z - l)}{(h-l)^2} + \frac{(Z + h - r)^2}{(h-l)^2} \left( r + \frac{Z + h - r}{3} \right) \right] + 2pq_{m1} (1 - q_{m1}) \left[ r \cdot \frac{Z + h - r}{h-l} \right]
\]

and it’s decreasing in \(r\) as long as the equilibrium is well-defined (\(q_{m1} \in (0,1)\)).
The optimal reserve price for such equilibrium with \( r \geq Z + l \) is

\[
\begin{cases}
  r_1(c_V) & \text{if } c_V \in (0, \frac{p(h-l)}{6}] \\
  Z + l & \text{if } c_V \in (\frac{p(h-l)}{6}, \frac{p(h-l)}{2}) \\
  N/A & \text{if } c_V \in [\frac{p(h-l)}{2}, +\infty)
\end{cases}
\]

Proof. The expression is straightforward. The derivative with respect to \( r \) is as below:

\[
\frac{\partial SR_{m1}}{\partial r} = \frac{6c_V(h-l)r\left[-6c_V(h-l) + p(h - r + Z)^2\right]}{p(h-r+Z)^5} = \frac{\partial q_{m1}}{\partial r} \cdot \frac{c_Vr}{(h-r+Z)}
\]

Therefore it’s non-positive as long as \( q_{m1} \in (0, 1) \).

Mixed strategy equilibrium with \( 0 \leq r < Z + l \)

Suppose bidder \( i \)'s opponent’s probability of acquiring is \( q \), then the payoff to bidder \( i \) if acquiring information and if \( 0 \leq r < Z + l \) is

\[
qp \int_{l}^{h} \frac{1}{h-l} \left( \frac{x_i-l}{h-l} \cdot \left( x_i + Z - \frac{(x_i + Z + Z + l)}{2} \right) \right) dx_i \\
+ (1 - q) p \int_{l}^{h} \frac{x_i + Z - r}{h-l} dx_i \\
- c_V
\]

Letting the payoff be zero (the payoff of not acquiring according to Lemma A.1), and solving for \( q \), we find the unique mixing probability. The probability is identical across the two symmetric bidders.

\[
q_{m2} = 1 - \frac{6c_V - p(h-l)}{2p(h+2l+3Z-3r)}
\]
This mixing probability $q_{m2}$ is decreasing in $c_V$:

$$\frac{\partial q_{m2}}{\partial c_V} = -\frac{3}{p(h + 2l + 3Z - 3r)} < 0$$

(since $h + 2l + 3Z - 3r = Z + h + 2(Z + l) - 3r > 0$)

It’s also decreasing in $r$ on $[0, Z + l]$ if and only if $c_V > \frac{p(h-l)}{6}$.

$$\frac{\partial q_{m2}}{\partial r} = \frac{3(-6c_V + p(h-l))}{2p(h + 2l + 3Z - 3r)^2}$$

$$\begin{cases} < 0 & \text{if } c_V > \frac{p(h-l)}{6} \\ \geq 0 & \text{if } c_V \leq \frac{p(h-l)}{6} \end{cases}$$

In addition,

$$q_{m2} \begin{cases} < 1 & \text{if } c_V > \frac{p(h-l)}{6} \\ \geq 1 & \text{if } c_V \leq \frac{p(h-l)}{6} \end{cases}$$

Therefore the mixed-strategy with $r \in [0, Z + l]$ only exists when $c_V > \frac{p(h-l)}{6}$.

Solving $q_{m2} = 0$ for $r$, one gets

$$r = Z - \frac{c}{p} + \frac{1}{2}(h + l)$$

$$\begin{cases} > Z + l & \text{if } c_V < \frac{p(h-l)}{2} \\ \leq Z + l & \text{if } c_V \geq \frac{p(h-l)}{2} \end{cases}$$

Then we have the following characterization of $q_{m2}$ as a function of $r$ on $[0, Z + l]$.

**Lemma A.4.** (1) when $c_V \in (0, \frac{p(h-l)}{6}]$, no mixed-strategy equilibrium with $r \in [0, Z + l]$ exists.

(2) when $c_V \in (\frac{p(h-l)}{6}, \frac{p(h-l)}{2})$, $q_{m2} \in (0, 1)$ and is decreasing in $r$. Such mixed-strategy equilibrium always exist.

(3) when $c_V \in [\frac{p(h-l)}{2}, +\infty)$, $q_{m2} < 1$ and is decreasing in $r$. It hits 0 at $Z - \frac{c}{p} + \frac{1}{2}(h + l) \leq Z + l$. So $q_{m1} \in (0, 1)$ and such mixed-strategy equilibrium exists if and only if $r \in \left[0, Z - \frac{c}{p} + \frac{1}{2}(h + l)\right]$. 

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Lemma A.5. The seller’s profit in a mixed-strategy acquisition equilibrium with \( r \in [0, Z + l] \) is

\[
SR_{m2} = pq_{m2}^2 \left[ Z + l + \frac{Z + h - Z - l}{3} \right]
+ 2pq_{m2} (1 - q_{m2}) r
\]

and it’s decreasing in \( r \) as long as the equilibrium is well-defined (\( q_{m2} \in (0, 1) \)).

The optimal reserve price for such equilibrium with \( r \geq Z + l \) is

\[
\begin{cases}
N/A & \text{if } c_V \in (0, \frac{p(h-l)}{6}] \\
0 & \text{if } c_V \in (\frac{p(h-l)}{6}, \frac{p(h-l)}{2}) \\
0 & \text{if } c_V \in [\frac{p(h-l)}{2}, +\infty)
\end{cases}
\]

Proof. The expression is straightforward. The derivative with respect to \( r \) is as below:

\[
\frac{\partial SR_{m2}}{\partial r} = -\frac{3r [6c_V - p(h-l)]^2}{2p (h + 2l - 3r + 3Z)^3} \leq 0
\]

Pure strategy, symmetric, both acquiring

If \( Z + l < r \leq Z + h \)

Suppose bidder \( i \)'s opponent’s probability of acquiring is 1, then the payoff to bidder \( i \) if acquiring information and if \( Z + l < r \leq Z + h \) is

\[
p \int_{r-Z}^{h} \frac{1}{h-l} \left[ \frac{x_i + Z - r}{h-l} \cdot \left( x_i + Z - \frac{(x_i + Z + r)}{2} \right) + \frac{r - Z - l}{h-l} \cdot (x_i + Z - r) \right] dx_i
- c_V
\]

(A.1)
(Let $\hat{r} = r - U$, where $r$ is the reserve price in benchmark model. And suppose $Z + l > Z - h > U$, hence if $r > Z + l$, $\hat{r} > 0$. Also, since $\hat{r} \geq 0$, $r \geq U$. $r > Z + h$ is not optimal, since no trade.

if $Z + l < r \leq Z + h$

$$p \int_{r-Z}^{h} \frac{1}{h-l} \left( x_i + Z - \frac{r}{h-l} \cdot \left( x_i + Z - \frac{x_i + Z - r + U}{2} \right) + \frac{r - Z - l}{h-l} \cdot (x_i + Z - r + U) + rest \cdot U \right) dx_i + (1-p) U$$

$$-c_V$$

$$= U - c_V + p \int_{r-Z}^{h} \frac{1}{h-l} \left( x_i + Z - \frac{r}{h-l} \cdot \left( x_i + Z - \frac{x_i + Z + r}{2} \right) + \frac{r - Z - l}{h-l} \cdot (x_i + Z - r) \right) dx_i$$

(A.4)

This profit > $U$ is EQ to the same condition as in the benchmark model.)

The payoff has to be higher than zero (the payoff of not acquiring according to Lemma [A.1]) for such equilibrium to exist. The derivative of the term (A.1) with respect to $r$ is $\frac{p(Z+h-r)(Z+l-r)}{(h-l)^4} \leq 0$. In addition, the term takes value $\frac{p(h-l)}{6} - c_V$ at $r = Z + l$. So we have the following lemma about existence of such equilibrium.

**Lemma A.6.** Consider $r \in [Z + l, Z + h]$.

1) when $c_V \in (0, \frac{p(h-l)}{6}]$, pure-strategy equilibrium with both acquiring exists if $r \in [Z + l, r_1(c_V)]$, where $r_1(c_V)$ is defined in Lemma [A.2]

2) when $c_V \in (\frac{p(h-l)}{6}, +\infty)$, no such equilibrium exists.

**Proof.** Only the proof of the threshold of $r_1(c_V)$ in non-trivial. Take derivatives of the equation of letting (A.1) be zero with respect to $c_V$, we got the same ODE as the one for $r_1(c_V)$. 

(In regions where such pure strategy equilibrium exists, we have the following lemma about the seller’s profit.

$$p \left[ (r - U) \cdot 2 \cdot \frac{(Z + h - r)(r - Z - l)}{(h-l)^2} + \frac{(Z + h - r)^2}{(h-l)^2} \left( r - U + \frac{Z + h - r}{3} \right) \right]$$

$$= p \left[ -U \left( 1 - \frac{(r - Z - l)^2}{(h-l)^2} \right) + r \cdot 2 \cdot \frac{(Z + h - r)(r - Z - l)}{(h-l)^2} + \frac{(Z + h - r)^2}{(h-l)^2} \left( r + \frac{Z + h - r}{3} \right) \right]$$

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the derivative w.r.t. $r$

$$-2\frac{(Z + l - r) \left( Z + h + U - 2r \right)}{(h - l)^2}$$

Since $r > Z + l$, $U < Z - h$, the derivative is negative. So the results keep unchanged. Only that the reserve price is $\hat{r} = r - U$, reduced by $U$ compared to the benchmark. The conditions of cv is the same. The seller’s revenue would be reduced by $pU$. But I believe the same happens in go-shop, because both bids reduce by $U$.

Try to stick to the benchmark as much as possible and compare the difference to the benchmark from two mechanisms.)

**Lemma A.7.** The seller’s profit in a pure-strategy acquisition equilibrium with both acquiring and $r \in [Z + l, Z + h]$ is

$$p \left[ r \cdot 2 \cdot \frac{(Z + h - r) (r - Z - l)}{(h - l)^2} + \frac{(Z + h - r)^2}{(h - l)^2} \left( r + \frac{Z + h - r}{3} \right) \right]$$

**Lemma A.8.** and it’s decreasing in $r$ as long as the equilibrium exists.

The optimal reserve price for such equilibrium with $r \geq Z + l$ is

$$\begin{cases} 
Z + l & \text{if } cv \in (0, \frac{p(h-l)}{6}] \\
N/A & \text{if } cv \in (\frac{p(h-l)}{6}, \frac{p(h-l)}{2})
\end{cases}$$

**Proof.** The expression is straightforward. The derivative with respect to $r$ is as below:

$$-\frac{2p (h - 2r + Z) (l - r + Z)}{(h - l)^2} \leq 0$$

where the inequality is because $h - 2r + Z \leq h - 2(Z + l) + Z = h - 2l - Z < h - Z < 0$ according to Assumption 2.
If $0 \leq r < Z + l$

If both has acquired information, when $V = Z$ the lowest bid would be higher or equal to $Z + l$. Therefore setting any $r \in [0, Z + l]$ would generate the same seller’s profit as $r = Z + l$. So the seller is indifferent between $r \in [0, Z + l]$.

Lemma A.9. Consider $r \in [0, Z + l]$.

(1) when $c_V \in (0, \frac{p(h-l)}{6}]$, pure-strategy equilibrium with both acquiring exists.

(2) when $c_V \in (\frac{p(h-l)}{6}, +\infty)$, no such equilibrium exists.

In regions where such pure strategy equilibrium exists, we have the following lemma about the seller’s profit.

Lemma A.10. The seller’s profit in a pure-strategy acquisition equilibrium with both acquiring and $r \in [0, Z + l]$ is

$$p \left[ r \cdot \frac{(Z + h - r) (r - Z - l)}{(h - l)^2} + \frac{(Z + h - r)^2}{(h - l)^2} \left( r + \frac{Z + h - r}{3} \right) \right]$$

and it remains the same for all $r$.

Pure strategy, asymmetric, only one acquiring

If $Z + l < r \leq Z + h$

Suppose bidder $i$’s opponent’s probability of acquiring is 1, then the payoff to bidder $i$ if acquiring information and if $Z + l < r \leq Z + h$ is

$$p \int_{r-Z}^{h} \frac{1}{h-l} \left[ \frac{x_i + Z - r}{h - l} \right] \cdot \left( x_i + Z - \frac{x_i + Z + r}{2} \right) + \frac{r - Z - l}{h - l} \cdot (x_i + Z - r) \, dx_i$$

$$- c_V$$

(A.5)

The payoff has to be lower than zero (the payoff of not acquiring according to Lemma A.1) for such equilibrium to exist. The derivative of the term (A.5) with respect to $r$ is $\frac{p(Z+h-r)(Z+l-r)}{(h-l)^2} \leq 0$. In addition, the term takes value $\frac{p(h-l)}{6} - c_V$ at $r = Z + l$. So we have the following lemma about existence of such equilibrium. Therefore for $c_V \in (0, \frac{p(h-l)}{6}]$, we need $r \geq r_1(c_V)$; for $c_V \in (\frac{p(h-l)}{6}, +\infty)$, there is no special requirement.
Then we consider if the opponent does not acquire information, whether the bidder would like to acquire information. The bidder’s payoff of acquiring information in this case is

\[ p \frac{Z + h - r}{h - l} \left( \frac{Z + h + r}{2} - r \right) - c_V \]

So we need

\[ r \leq r_0 (c_V) \]

where \( r_0 (c_V) \) is defined in Lemma \textbf{A.11}.

\textbf{Lemma A.11.} Consider \( r \in [Z + l, Z + h] \). Then the existence condition for pure asymmetric strategy equilibrium is the same as that for mixed strategy equilibrium characterized in Lemma \textbf{A.11}.

In regions where such pure strategy equilibrium exists, we have the following lemma about the seller’s profit.

\textbf{Lemma A.12.} The seller’s profit in a pure-strategy acquisition equilibrium with both acquiring and \( r \in [Z + l, Z + h] \) is

\[ p \left[ r \cdot \frac{(Z + h - r)}{(h - l)} \right] \]

and it’s decreasing in \( r \) as long as the equilibrium exists.

The optimal reserve price for such equilibrium with \( r \geq Z + l \) is

\[
\begin{cases} 
  r_1 (c_V) & \text{if } c_V \in (0, \frac{p(h-l)}{6}] \\
  Z + l & \text{if } c_V \in (\frac{p(h-l)}{6}, \frac{p(h-l)}{2}) \\
  N/A & \text{if } c_V \in [\frac{p(h-l)}{2}, +\infty) 
\end{cases}
\]

\textbf{Proof.} The expression is straightforward. The derivative with respect to \( r \) is as below:

\[
(h - 2r + Z) \leq 0
\]

where the inequality is because \( h - 2r + Z \leq h - 2(Z + l) + Z = h - 2l - Z < h - Z < 0 \) according to
Assumption 2

If \( 0 \leq r < Z + l \)

If the opponent has acquired information, the bidder should not acquire. The profit of acquiring is

\[
p \int_{l}^{h} \frac{1}{h-l} \left[ x_i - l \left( x_i + \frac{x_i + Z + Z + l}{2} \right) \right] dx_i
\]

\[-c_V = \frac{p(h-l)}{6} - c_V]

So we need \( \frac{p(h-l)}{6} - c_V < 0 \).

If the opponent has not acquired information, the bidder should acquire. So

\[
p \left( Z + \frac{h+l}{2} - r \right) - c_V > 0
\]

or

\[
r < Z + \frac{1}{2} (h+l) - \frac{c_V}{p}.
\]

**Lemma A.13.** Consider \( r \in [0, Z + l] \).

1. when \( c_V \in (0, \frac{p(h-l)}{6}) \), pure-strategy asymmetric equilibrium with only one acquiring does not exist.
2. when \( c_V \in (\frac{p(h-l)}{6}, \frac{p(h-l)}{2}) \), such equilibrium always exists.
3. when \( c_V \in [\frac{p(h-l)}{2}, +\infty) \), such equilibrium exists when \( r \in [0, r_3(c_V)] \), where \( r_3(c_V) = Z + \frac{1}{2} (h+l) - \frac{c_V}{p} \).

In regions where such pure strategy equilibrium exists, we have the following lemma about the seller’s profit.

**Lemma A.14.** The seller’s profit in a pure-strategy acquisition equilibrium with both acquiring and \( r \in [0, Z + l] \) is

\[ pr \]
and it’s increasing in r. So the optimal r is

\[
\begin{align*}
\text{if } c_V \in \left( \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right) & \quad Z + l \\
\text{if } c_V \in \left[ \frac{p(h-l)}{2}, p(Z + \frac{1}{2}(h+l)) \right] & \quad Z + \frac{1}{2}(h+l) - \frac{c_V}{p}
\end{align*}
\]

Pure strategy, symmetric, no one acquires

In this case the seller’s profit is 0.

Optimal Reserve Price and Optimal Revenue

According to Lemma [A.2] to [A.14], and compare revenues, we have the following proposition which can be written in a simpler way as Proposition [3.1]

**Proposition [3.1]**

1. when \( c_V \in [0, \frac{p(h-l)}{6}] \), the optimal reserve price is \( r = 0 \). Under this reserve price, the exists a unique equilibrium with both bidders acquire information. The seller’s profit is \( p \left( Z + l + \frac{h-l}{3} \right) \).

2. when \( c_V \in \left( \frac{p(h-l)}{6}, \frac{p(h-l) + 2Z}{2} \right) - p\sqrt{\frac{(Z+l)(h+2l+3Z)}{3}} \), the optimal reserve price is \( r = 0 \). Under this reserve price, there exists both mixed-strategy equilibrium and asymmetric equilibria with only one bidder acquiring. In the equilibrium that gives the seller higher profit, bidders acquire information with mixed strategy, where the mixing probability is \( 1 - \frac{6c_V - p(h-l)}{2p(h+2l+3Z-3l)} \). The seller’s profit is \( \frac{3(p(h+1+2Z) - 2c_V)^2}{4p(h+2l+3Z)} \).

3. when \( c_V \in \left( \frac{p(h-l) + 2Z}{2}, p \left( \frac{Z}{3} + \frac{1}{2}(h+l) \right) \right] \), the optimal reserve price is \( r = Z + l \). Under this reserve price, there exists both mixed-strategy equilibrium and asymmetric equilibria with only one bidder acquiring. In the equilibrium that gives the seller higher profit, only one bidder acquires. The seller’s profit is \( p \left( Z + l \right) \).

4. when \( c_V \in \left( \frac{p(h-l)}{2}, p \left( Z + \frac{1}{2}(h+l) \right) \right] \), the optimal reserve price is \( r = r_3(c_V) = Z + \frac{1}{2}(h+l) - \frac{c_V}{p} \). Under this reserve price, there exists both mixed-strategy equilibrium and asymmetric equilibria with only one bidder acquiring. In the equilibrium that gives the seller higher profit, only one bidder acquires. The seller’s profit is \( p \left( Z + \frac{1}{2}(h+l) - \frac{c_V}{p} \right) \).

5. when \( c_V \in (p \left( Z + \frac{1}{2}(h+l) \right), +\infty) \), there exists a unique equilibrium in which no one acquires. The seller’s profit is 0.
The revenue is summarized as below:

**Proposition A.1.** The maximum of seller’s revenue in a standard English auction among all equilibria is

\[
SR_{\text{auc}} = \begin{cases} 
  p \left( Z + l + \frac{h-l}{3} \right), & \text{if } c_V \in \left[ 0, \frac{p(h-l)}{6} \right] \\
  \frac{3(p(h+l+2Z)-2c_V)^2}{4p(h+2l+3Z)}, & \text{if } c_V \in \left( \frac{p(h-l)}{6}, \frac{p(h+l+2Z)}{2} - \sqrt{\frac{(Z+l)(h+2l+3Z)^3}{3}} \right) \\
  p(Z+l), & \text{if } c_V \in \left( \frac{p(h+l+2Z)}{2} - \sqrt{\frac{(Z+l)(h+2l+3Z)^3}{3}}, \frac{p(h-l)}{2} \right) \\
  p \left( Z + \frac{1}{2} (h + l) - \frac{c_V}{p} \right), & \text{if } c_V \in \left( \frac{p(h-l)}{2}, p \left( Z + \frac{1}{2} (h + l) \right) \right) \\
  0, & \text{if } c_V \in \left( p \left( Z + \frac{1}{2} (h + l) \right), +\infty \right).
\]
B Go-Shop Negotiation

Derivation of the seller’s optimization problem: Problem (3.2)

First, we check if bidder 2 does not acquire information after observing bidder 1’s decision. This is trivially true because bidder 1’s action reveals perfectly the value of $V$. Bidder 2’s participation constraint that the equilibrium utility must be higher than the outside option $n$ is also true because no information acquisition cost is paid and the profit of an informed bidder in an English auction is non-negative. Bidder 2’s belief is also consistent with Bayesian updating and bidder 1’s strategy. Therefore, we have proven part (iii) of Proposition 3.2.

Next, we study bidder 1’s acceptance and rejection decision after acquiring information. Suppose the optimal $\Delta \in [0, h - l]$, which will be verified later in the Appendix.

If $V = -Z$, bidder 1 is supposed to turn down the price floor and obtain its outside option $n$. If bidder 1 accepts the offer instead, he will drop out at $b_1$ to minimize the chance of winning because bidder 2’s net valuation from winning is $n - Z + x_2 - n = -Z + x_2$, which is negative according to Assumption 1. Therefore, bidder 1 with $V = -Z$ rejects the price floor $\forall x_1 \in [l, h]$ if

\[ P(x_2 < l + \Delta) (n + m - Z + x_1 - b_1) + (1 - P(x_2 < l + \Delta)) (n + TF) < n, \forall x_1 \]

\( \Leftrightarrow TF + \frac{\Delta}{h - l} (-2Z + x_1 - l - \Delta) < 0, \forall x_1 \]

\( \Leftrightarrow TF < \frac{\Delta}{h - l} (2Z - h + l + \Delta). \quad (B.1) \)

If $V = Z$, we need to make sure that bidder 1 accepts the price floor.

If $x_1 \geq l + \Delta$, bidder 1’s bid is unaffected by the price floor $b_1 = m + Z + l + \Delta - TF$, since this is the minimum price for him to drop out of the English auction. Then $b_1 = m + u_1 - TF$, $b_2 = m + u_2 - TF$.

Then, bidder 1’s expected payoff by accepting the price floor is

\[ P(x_2 \geq l + \Delta) (P(x_1 \geq x_2 | x_2 \geq l + \Delta) \mathbb{E}[n + m + Z + x_1 - m - Z - x_2 + TF|x_1 \geq x_2, x_2 \geq l + \Delta] + P(x_1 < x_2 | x_2 \geq l + \Delta) (n + TF)) + P(x_2 < l + \Delta) (n + m + Z + x_1 - b_1) \]

\[ = n + TF + \frac{(x_1 - l - \Delta)^2}{2(h - l)} + \frac{\Delta}{h - l} (x_1 - l - \Delta) \geq U, \forall TF \geq 0, x_1 \in [l + \Delta, h] \]
Therefore, bidder 1 with \( x_1 \geq l + \Delta \) always accepts the price floor for any non-negative \( TF \).

If \( x_1 < l + \Delta \) and bidder 1 accepts the price floor, he would bid \( b_1 \) to minimize his loss. Then, bidder 1 with \( x_1 \) accepts the price floor if

\[
P (x_2 < l + \Delta) (n + m + Z + x_1 - b_1) + (1 - P (x_2 < l + \Delta)) (n + TF) \geq n
\]

\[
\Leftrightarrow \frac{\Delta}{h-l}(x_1 - l - \Delta) + TF \geq 0
\]

\[
\Leftrightarrow x_1 \geq l + \Delta - TF \frac{h-l}{\Delta}.
\]

Therefore, if \( TF \geq \frac{\Delta^2}{h-l} \) (i.e., \( \Delta - TF \frac{h-l}{\Delta} \leq 0 \)), then all \( x_1 < l + \Delta \) accept the price floor and bid \( b_1 \).

In this case, bidder 1’s bid is

\[
b_1 = \begin{cases} 
  m + Z + x_1 - TF, & x_1 \geq l + \Delta \\
  b_1, & x_1 < l + \Delta 
\end{cases}
\]

Therefore, bidder 1 with \( V = Z \) accepts the price floor for all \( x_1 \in [l,h] \) if and only if

\[
TF \geq \frac{\Delta^2}{h-l}.
\]  \hspace{1cm} (B.2)

Finally, we look for the conditions under which bidder 1 is willing to acquire information. If bidder 1 does not acquire information and rejects the price floor, he obtains \( n \). If he accepts the price floor, the best he can do is to bid \( b_1 \) in the auction because his gains from trade with the target is negative for all \( x_1 \) according to Assumption 2. Therefore, he gets

\[
P (x_2 < l + \Delta) (n + m + \mathbb{E} (V) + x_1 - b_1) + (1 - P (x_2 < l + \Delta)) (n + TF)
\]

\[
= n + \frac{\Delta}{h-l} (Zp + (1-p)(-Z) + x_1 - Z - l - \Delta + TF) + \frac{h-l-\Delta}{h-l} TF
\]

\[
= n + TF + \frac{\Delta}{h-l} (-2Z (1-p) + x_1 - l - \Delta)
\]  \hspace{1cm} (B.3)

Hence, bidder 1’s expected utility if not acquiring information about \( V \) is

\[
n + \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (-2Z (1-p) + x_1 - l - \Delta) \right] \}.
\]
We then derive the expression for bidder 1’s expected utility if acquiring information. In this case, with $TF \geq \frac{\Delta^2}{h-l}$, all $x_1$ accepts the price floor. Bidder 1’s utility of acquiring information is then

$$U_1 = -cV + n + p \cdot P(x_2 \geq l + \Delta) \cdot \{P(x_1 \leq x_2 | x_1, x_2 \geq l + \Delta) TF$$

$$+ P(x_1 \geq x_2 | x_1, x_2 \geq l + \Delta)$$

$$\cdot \mathbb{E}(x_1 + Z - Z - x_2 + TF | x_1 \geq x_2, x_1, x_2 \geq l + \Delta)\}$$

$$+ p \cdot P(x_2 < l + \Delta) \mathbb{E}(x_1 + Z - Z - l - \Delta + TF | x_2 < l + \Delta)$$

$$+ p \cdot P(x_2 \geq l + \Delta) \mathbb{E}(x_1 < l + \Delta) TF$$

$$= -cV + n + p \left[ TF + \frac{(h - l - \Delta)^3}{6(h-l)^2} + \frac{\Delta}{h-l} \left( \frac{l+h}{2} - l - \Delta \right) \right].$$

Hence, for bidder 1 to acquire information, we need

$$U_1 \geq n + \mathbb{E}_{x_1} \{ \max \left( 0, TF + \frac{\Delta}{h-l} (-2Z(1-p) + x_1 - l - \Delta) \right) \} \quad (B.4)$$

In addition, for bidder 1 to be willing to enter the mechanism, we need

$$U_1 \geq n. \quad (B.5)$$

Combine the conditions $(B.1)$ to $(B.5)$, recall that Assumption 4 leads to $TF \geq 0$, we derive Problem (3.2).

Proof of Proposition 3.4.

Denote $U_1$ in the fully revealing case as $U_{1,FA}$ (full acceptance, as compared to the partial acceptance case). A sufficient condition for $(b)$ is

$$\left\{\begin{array}{l}
TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \leq 0, \forall x_1 \in [l, h] \\
U_{1,FA} \geq n + \mathbb{E}_{x_1} \{0\} = n
\end{array} \right.$$
\[ \begin{cases} (b') & \Delta \leq \frac{\Delta}{h-l} (2Z(1-p)-h+l) \\ (a) & U_{1,FA} \geq n \end{cases} \]

\[ \frac{\partial SR_1}{\partial TF} = -p < 0 \] and \[ \frac{\partial SR_1}{\partial \Delta} = \frac{p\Delta(2(h-l)-\Delta)}{(h-l)^2} > 0. \] Ignore all constraints except constraint \((a)\), we find the optimal solution is \((\Delta, TF) = \left( \frac{2}{3} (h-l), \frac{17}{162} (h-l) + \frac{cV}{p} \right)\). In order to satisfy \((c), (f), (d), (b'), (c)\), we need \(c_V \in [\frac{h-l}{162^{2/5}}, \frac{4}{5}p(1-p)Z - \frac{17}{162p(h-l)}] \) (only \((c)\) and \((b')\) are binding).

Focus on the case with \(c_V < \frac{4}{5}p(1-p)Z - \frac{17}{162p(h-l)}\), where the information acquisition cost not unreasonably large.

When \(c_V \in \left[ \frac{h-l}{6}, \frac{h-l}{162^{2/5}} \right)\), we must have \(U_{1,FA} = n\) and \(TF = \frac{\Delta^2}{h-l}\) at the optimum. To see this, \(U_{1,FA} \geq n\) is equivalent to \(TF \geq \frac{\Delta^3+(h-l)(3\Delta^2+(h-l)(6\frac{cV}{p}-h+l))}{6(h-l)^2}\). The slope of \(TF = \frac{\Delta^3+(h-l)(3\Delta^2+(h-l)(6\frac{cV}{p}-h+l))}{6(h-l)^2}\) with respect to \(\Delta\) is \(\frac{\Delta(\Delta+2(h-l))}{2(h-l)^2} > 0\), which is smaller than the slope of \(TF = \frac{\Delta^2}{h-l}\) for all \(\Delta \in [0, h-l]\). Therefore on the \((\Delta, TF)\) space with \(TF \geq 0\) and \(\Delta \in [0, h-l]\), if the two lines intersect, \(TF = \frac{\Delta^2}{h-l}\) crosses \(TF = \frac{\Delta^3+(h-l)(3\Delta^2+(h-l)(6\frac{cV}{p}-h+l))}{6(h-l)^2}\) only once and from below. Note that at \(c_V = \frac{h-l}{162^{2/5}}\), the two lines intersect at \((\Delta, TF) = \left( \frac{2}{3} (h-l), \frac{17}{162} (h-l) + \frac{cV}{p} \right)\). When \(c_V\) decreases from \(\frac{h-l}{162^{2/5}}\), the intersect moves down along \(TF = \frac{\Delta^2}{h-l}\), and reaches \((0,0)\) when \(c_V = \frac{h-l}{6}\). Since the slope of the tangent line to the contour of \(SR_1\) is \(\frac{\partial SR_1}{\partial \Delta} = \frac{\Delta(2(h-l)-\Delta)}{(h-l)^2}\) lies between the slopes of \(TF = \frac{\Delta^3+(h-l)(3\Delta^2+(h-l)(6\frac{cV}{p}-h+l))}{6(h-l)^2}\) and the slope of \(TF = \frac{\Delta^2}{h-l}\) whenever \(0 < \Delta < \frac{2}{3} (h-l)\), the intersection of \(TF = \frac{\Delta^3+(h-l)(3\Delta^2+(h-l)(6\frac{cV}{p}-h+l))}{6(h-l)^2}\) and \(TF = \frac{\Delta^2}{h-l}\) is the optimal solution for \(c_V \in [\frac{h-l}{6}, \frac{h-l}{162^{2/5}}]\). Since \(\frac{\Delta}{h-l} (2Z(1-p)-h+l+\Delta) > \frac{\Delta^2}{h-l}\) and at the optimum \(TF = \frac{\Delta^2}{h-l}\), so \((d')\) holds. Therefore all constraints are satisfied. Finally, when \(c_V \leq \frac{h-l}{6}\), \(TF \geq 0\) and \(TF \geq \frac{\Delta^2}{h-l}\) are binding while \(U_{1,FA} > n\).

Considering the slope of the tangent line to the contour of \(SR_1\), the optimal solution is then \((0,0)\).

Finally, I need to prove that \(\Delta < 0\) or \(\Delta > h-l\) is not as good as the solution I’ve found. Suppose \(\Delta < 0\), then there exists no equilibrium fully revealing \(V\). This is because no bidder 2 would be excluded from the game by the reserve price \(b_1 + TF\). As long as \(TF > 0\), then bidder 1 who learns that \(V = -Z\) will pretend that \(V = Z\) to get \(TF\) for free by bidding \(b_1\) and always loses to bidder 2. Therefore, \(TF = 0\). But bidder 1 will not acquire information when \(c_V > \frac{b(h-l)}{6}\), because \(TF\) is not large enough to compensate bidder 1’s loss when \(V = Z\). Finally, \(\Delta > h-l\) cannot be optimal, since all bidder 2 would be excluded from the game.

\[ \text{QED.} \]

\textbf{Proof of Proposition 3.3.}
First, I consider a go-shop negotiation mechanisms in which bidder 1 with \( x_1 \) that is low enough rejects the price floor \( b_1 \), which I refer to as a *go-shop negotiation with Partial Acceptance*. In this type of equilibrium, bidder 1’s decision of whether to accept \( b_1 \) does not fully reveal \( V \) because \( b_1 \) could be rejected either because \( V = -Z \) or because \( V = Z \) but \( x_1 \) is too small. I show that the optimal mechanism I considered in the previous section remains optimal if I consider this additional case.

**Proposition B.1.** A *go-shop negotiation with partial acceptance* from bidder 1 with \( V = Z \) generates no greater revenue to the seller than the optimal go-shop negotiation fully revealing \( V \) stated in Proposition 3.4.

Second, I will also consider other types of equilibria, e.g., no bidder acquires information. The optimal solution in Proposition 3.4 remains the optimal one. I’ll focus on the proof of Proposition B.1.

**Proof of Proposition B.1.** We derive the optimal go-shop negotiation with partial acceptance and compare it with that fully revealing \( V \). That is, even with \( V = Z \), there are some types of \( x_1 \) will reject the price floor. This case is true when \( TF < \frac{\Delta^2}{h-l} \).

Assume that the seller’s optimal reserve price is \( r_{B^2} = m + Z + l \). I’ll show that this assumption does not affect the result later.

If \( TF < \frac{\Delta^2}{h-l} \) (i.e., \( \Delta - TF \frac{h-l}{\Delta} > 0 \)), then \( x_1 \in \left[l + \Delta - TF \frac{h-l}{\Delta}, l + \Delta \right] \) accepts while \( x_1 \in \left[l, l + \Delta - TF \frac{h-l}{\Delta} \right] \) rejects. In this case, bidder 1’s bid is

\[
b_1 = \begin{cases} 
  m + Z + x_1 - TF, & x_1 \geq l + \Delta \\
  b_1, & x_1 \in \left[l + \Delta - TF \frac{h-l}{\Delta}, l + \Delta \right] \\
  N/A (excluded), & x_1 \in \left[l, l + \Delta - TF \frac{h-l}{\Delta} \right]
\end{cases}
\]  

(B.6)

Next, we consider bidder 2’s belief and bidding strategy if observing bidder 1’s acceptance or rejection. As has been discussed, if seeing acceptance, bidder 2 believes that \( V = Z \), and bids \( b_2 = m + Z + x_2 - TF \).
If observing rejection, bidder 2 has the following belief:

\[
Pr_{PA}(V = Z | \text{rejection}) = \frac{Pr(V = Z, \text{ bidder 1 rejects})}{Pr(V = Z, \text{ bidder 1 rejects}) + Pr(V = -Z, \text{ bidder 1 rejects})}
\]

\[
= \frac{p \frac{1 + \Delta - TF \frac{h-l}{h-l}}{h-l} - l}{p \frac{1 + \Delta - TF \frac{h-l}{h-l}}{h-l} + (1 - p) \left( \Delta - TF \frac{h-l}{\Delta} \right)} + (1 - p) \left( \Delta - TF \frac{h-l}{h-l} \right)
\]

Hence if \( TF < \frac{\Delta^2}{h-l} \), bidder 2 might still acquire information, since it is likely that \( V = Z \) and bidder 1 rejects the price floor only because \( x_1 \) is low. Due to Assumption 2 and the fact that bidder 2 becomes more pessimistic after seeing rejection, bidder 2 won’t bid above zero if without looking into the value of \( V \) herself. So bidder 2 gets zero if not acquiring. If bidder 2 acquires, she knows about \( V \). Then if bidder 2 acquires, with probability \( Pr_{PA}(V = Z | \text{rejection}), V = Z \), then bidder 2 gets \( \mathbb{E}(m + Z + x_2 - r_{B2}) = m + Z + \frac{h+l}{2} - m - Z - l = \frac{h-l}{2} \); with the complementary probability, \( V = -Z \) and bidder 2 gets zero. So bidder 2 acquires information seeing rejection if and only if

\[
\frac{p \left( \Delta - TF \frac{h-l}{\Delta} \right)}{p \left( \Delta - TF \frac{h-l}{h-l} \right) + (1 - p) \left( h - l \right)} \cdot \frac{h - l}{2} + \frac{h}{2} - c_V - n \geq 0
\]

which is equivalent to the following. If \( c_V > \frac{h-l}{2} \), then bidder 2 does not acquire information and always drops from the game; if \( c_V \leq \frac{h-l}{2} \), bidder 2 acquires if \( TF \leq \frac{\Delta^2}{h-l} - \frac{1 - p}{2} \cdot \frac{\Delta}{2c_V} \).

If \( TF < \frac{\Delta^2}{h-l} \), then \( x_1 \in \left[ l + \Delta - TF \frac{h-l}{\Delta}, l \right] \) accepts while \( x_1 \in \left[ l, l + \Delta - TF \frac{h-l}{\Delta} \right] \) rejects. \( b_1 \) is specified in equation \((B.6)\). Bidder 1’s utility of acquiring information under bidder 1’s partial acceptance is then

\[
U_{1,PA} = -c_V + n + p \cdot P(x_2 \geq l + \Delta)P(x_1 \geq l + \Delta) \left( P(x_1 < x_2)TF + P(x_1 \geq x_2) \mathbb{E}(x_1 + Z - Z - x_2 + TF|x_1 \geq x_2, x_1 \geq l + \Delta, x_2 \geq l + \Delta) \right)
\]

\[
+ P(x_2 \geq l + \Delta) \mathbb{E}(x_1 + Z - Z - x_2 + TF|x_1 \geq x_2, x_1 \geq l + \Delta, x_2 \geq l + \Delta)
\]

\[
+ P(x_2 \leq l + \Delta) \mathbb{E}(x_1 \geq l + \Delta - TF \frac{h-l}{\Delta}) \left( Z + x_1 - Z - l - \Delta + TF|x_1 \geq l + \Delta - TF \frac{h-l}{\Delta} \right)
\]

\[
+ P \left( x_1 < l + \Delta - TF \frac{h-l}{\Delta} \right) \cdot 0
\]

\[
= -c_V + n + p \left[ TF \left( 1 - \frac{\Delta - TF \frac{h-l}{h-l}}{h-l} \right) + \frac{(h-l-\Delta)^3}{6(h-l)^3} + \frac{\Delta}{h-l} \left( 1 - \frac{\Delta - TF \frac{h-l}{h-l}}{\Delta} \right) \left( \frac{l + h + (\Delta - TF \frac{h-l}{h-l})}{2} - l - \Delta \right) \right].
\]
Hence we need $U_{1,PA} \geq n$ for participation constraint and $U_{1,PA} \geq n + \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \right] \}$ for bidder 1 to acquire information.

Now we’ve identified all conditions for a partial equilibrium in which bidder 1 acquires information and accepts the price floor $b_1$ only if $V = Z$ (partial acceptance). Refer to the case fully revealing $V$ as Form 1, the seller’s problem has three possible forms with partial acceptance.

**Form 2 (true when $c_V > \frac{h-l}{2}$):** Bidder 1 with smaller $x_1$ rejects even if $V = Z$. Bidder 2 does not acquire if seeing rejection, dropping from the game.

\[
\begin{align*}
\max_{\Delta, TF} & \quad SR2 = m + (1-p) \cdot 0 + p[P(x_2 \geq l + \Delta) P(x_1 \geq l + \Delta) \mathbb{E}(Z + \min(x_1, x_2) - TF|x_1 \geq l + \Delta, x_2 \geq l + \Delta) \\
& \quad + P(x_2 \geq l + \Delta) P \left( x_1 \in \left[ l + \Delta - \frac{h-l}{\Delta}, l + \Delta \right] \right) (Z + l + \Delta - TF) \\
& \quad + P(x_2 < l + \Delta) P \left( x_1 \geq l + \Delta - \frac{h-l}{\Delta} \right) (Z + l + \Delta - TF) \\
& \quad + \left( x_1 < l + \Delta - TF \frac{h-l}{\Delta} \right) \cdot 0] \\
= & \quad m + p \left[ (Z + l + \Delta - TF) \left( 1 - \frac{\Delta - TF h-l}{h-l} \right) + \frac{(h-l-\Delta)^3}{3(h-l)^2} \right] \\
\text{s.t.} & \quad TF \geq 0 \\
& \quad 0 \leq \Delta \leq h-l \\
& \quad TF \leq \frac{\Delta}{h-l} (2Z - h + l + \Delta) \\
& \quad U_{1,PA} \geq n + \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \right] \} \\
& \quad TF \leq \frac{\Delta^2}{h-l} \\
& \quad U_{1,PA} \geq n
\end{align*}
\]

**Proposition B.2.** Form 2 is dominated by Form 1.

**Proof.** Cutting $TF$ below $\frac{\Delta^2}{h-l}$ saves the seller’s payment to bidder 1 through lower $TF$ and also reduce the prob that the seller has to pay $TF$, yet also results in lower probability of trade if $V = Z$. That is, if bidder 1 is excluded, bidder 2 drops too. Therefore it is not worthwhile to cut $TF$ as long as bidder 2 never acquires information.

Formally, $\frac{\partial SR2}{\partial TF} = \frac{p(\Delta^2 + Z + l - 2TF)}{\Delta}$. $TF \leq \frac{\Delta^2}{h-l}$ implies that $TF \leq \Delta$ as long as $0 \leq \Delta \leq h-l$. In addition, Assumption 2 implies that $Z > h > h-l \geq \Delta$. So $TF \leq \Delta < Z < Z+l$, then $Z+l-2TF > -TF$. Therefore $\frac{\partial SR2}{\partial TF} = \frac{p(\Delta^2 + Z + l - 2TF)}{\Delta} > \frac{p(\Delta^2 - TF)}{\Delta} \geq 0$ for $TF \leq \frac{\Delta^2}{h-l}$ and $0 \leq \Delta \leq h-l$. Moreover,
\[ \frac{\partial U_{1,PA}}{\partial TF} = p \left( 1 - \frac{\Delta}{h-l} + \frac{TF}{T} \right) \geq 0 \] as long as \( TF \geq 0 \) and \( \Delta \in [0, h-l] \). Now we show that the optimal solution for Form 2 must have \( TF = \frac{\Delta^2}{h-l} \). Suppose \( TF < \frac{\Delta^2}{h-l} \) at the optimum. Then rise \( TF \) to \( \frac{\Delta^2}{h-l} \) weakly improves seller’s revenue \( SR2 \), makes the constraint \( U_{1,PA} \geq n \) looser, and still satisfies all other conditions. Hence there must be an optimal solution for form 2 with \( TF = \frac{\Delta^2}{h-l} \). We also have \( U_{1,PA} = U_{1,FA} \), \( SR1 = SR2 \) at \( TF = \frac{\Delta^2}{h-l} \). So the optimal solution in form 2 also satisfies the constraints in form 1, and achieves the same revenue. Therefore the optimal revenue in Form 1 is at least as high as the optimal revenue in Form 2.

**Form 3** (true when \( c_V < \frac{h-l}{2} \)): Bidder 1 with smaller \( x_1 \) rejects even if \( V = Z \). Bidder 2 does not acquire if seeing rejection, dropping from the game.

\[
\begin{align*}
\max_{\Delta,TF} & \quad SR3 = SR2 = m + p \left[ (Z + l + \Delta - TF) \left( 1 - \frac{\Delta - TF h-l}{h-l} \right) + \frac{(h-l-\Delta)^3}{3(h-l)^2} \right] \\
\text{s.t.} & \quad TF \geq 0 \\
& \quad 0 \leq \Delta \leq h-l \\
& \quad TF \leq \frac{\Delta}{h-l} (2Z - h + l + \Delta) \\
& \quad U_{1,PA} \geq n + \mathbb{E}_{\xi_1} \left\{ \max \left[ 0, TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \right] \right\} \\
& \quad TF \leq \frac{\Delta^2}{h-l} \\
& \quad TF \geq \frac{\Delta^2}{h-l} - \frac{1-p}{p} \frac{\Delta}{h-l} \\
& \quad U_{1,PA} \geq n
\end{align*}
\]

**Proposition B.3.** Form 3 is dominated by Form 1 (for the same reasons in form 2).
Form 4 (true when \(c_V < \frac{h-l}{2}\)): Bidder 1 with smaller \(x_1\) rejects even if \(V = Z\). Bidder 2 acquire information if seeing rejection, paying \(r_{B2} = m + Z + l\) if finding out \(V = Z\).

\[
\max_{\Delta, TF} SR4 = m + (1-p) \cdot 0 + p P(x_2 \geq l + \Delta) P(x_1 \geq l + \Delta) E(Z + \min(x_1, x_2) - TF|x_1 \geq l + \Delta, x_2 \geq l + \Delta) \\
+ P(x_2 \geq l + \Delta) P(x_1 \in \left[l + \Delta - TF \frac{h-l}{\Delta}, l + \Delta\right]) (Z + l + \Delta - TF) \\
+ P(x_2 < l + \Delta) P(x_1 \geq l + \Delta - TF \frac{h-l}{\Delta}) (Z + l + \Delta - TF) \\
+ P(x_1 < l + \Delta - TF \frac{h-l}{\Delta}) (Z + l) \\
= m + p \left[ (Z + l + \Delta - TF) \left( 1 - \Delta - TF \frac{h-l}{h-l} \right) + (Z + l) \frac{\Delta - TF h-l}{h-l} + \frac{(h-l-\Delta)^3}{3(h-l)^2} \right] 
\]

\[
\text{s.t.} \quad TF \geq 0 \\
0 \leq \Delta \leq h-l \\
TF \leq \frac{\Delta}{h-l} (2Z - h + l + \Delta) \\
U_{1,PA} \geq n + \mathbb{E}_{x_1} \left( \max \left[ 0, TF + \frac{\Delta}{h-l} (E(V) + x_1 - Z - l - \Delta) \right] \right) \\
TF \leq \frac{\Delta^2}{h-l} - \frac{1-p}{p} \frac{\Delta}{2c_V - 1} \\
U_{1,PA} \geq n
\]

**Proposition B.4.** Form 4 is dominated by Form 1.

**Proof.** Extending the domain of form 4 to the union of form 3 and form 4’s domain, which adjoins the domain of form 1. If we can show that the optimum of \(SR4\) on this larger domain is at the boundary of the domain of form 1, we can prove the optimum of form 1 is no less than that of form 4. The new domain is

\[
\{(\Delta, TF) \in \mathbb{R}^2 \mid TF \geq 0, \\
0 \leq \Delta \leq h-l, \\
TF \leq \frac{\Delta^2}{h-l}, \\
U_{1,PA} \geq n\}
\]
To see this, \( \frac{\partial SR4}{\partial TF} = \frac{\Delta p}{h-l} - 2pTF > 0 \) when \( TF < \frac{1}{2} \frac{\Delta^2}{h-l} \) and \( < 0 \) when \( TF > \frac{1}{2} \frac{\Delta^2}{h-l} \). \( \frac{\partial SR4}{\partial \Delta} = p \left[ -\frac{\Delta^2}{(h-l)^2} + \frac{TF}{h-l} + \frac{TF^2}{\Delta^2} \right] < 0 \) when \( TF < \frac{\sqrt{5}-1}{2} \frac{\Delta^2}{h-l} \) and \( > 0 \) when \( TF > \frac{\sqrt{5}-1}{2} \frac{\Delta^2}{h-l} \). Therefore the global maximum for \( TF \geq 0 \) and \( \Delta \geq 0 \) is \((0,0)\).

The slope of \( U_{1,PA} = n \) is strictly positive when \( \Delta \in (0, h-l), TF > 0 \). Also, it crosses \( TF = \frac{\Delta^2}{h-l} \) once and from below, and the intersect is to the left of \( \Delta = h-l \). When \( c_V \leq \frac{p(h-l)}{6} \), the domain of form 3&4 includes \((0,0)\), hence the optimal solution for \( SR4 \) in this region is \((0,0)\), which also belongs to the domain of form 1. When \( c_V > \frac{p(h-l)}{6} \), the domain of form 3&4 becomes a triangle region:

\[
A = \{(\Delta, TF) \in \mathbb{R}^2 \mid \Delta \leq h-l,
TF \leq \frac{\Delta^2}{h-l},
U_{1,PA} \geq n\}
\]

Now I show that the optimum in this region is the intersection of \( TF = \frac{\Delta^2}{h-l} \) and \( U_{1,PA} = n \). To see this, any interior point in region \( A \) is not optimal, since a necessary condition for a interior optimum is that \( \frac{\partial SR4}{\partial TF} = \frac{\partial SR4}{\partial \Delta} = 0 \), and the only solution to that is \((0,0)\) which is outside of region \( A \). According to the sign of the partial derivatives of \( SR4 \), the optimum cannot be on \( TF = \frac{\Delta^2}{h-l} \), and has to be on \( U_{1,PA} = n \).

In addition, on the line of \( U_{1,PA} = 0 \), the optimum cannot have \( TF \geq \frac{1}{2} \frac{\Delta^2}{h-l} \) because that would be dominated by an interior point to its north-west. \( \frac{\sqrt{5}-1}{2} \frac{\Delta^2}{h-l} < TF < \frac{1}{2} \frac{\Delta^2}{h-l} \) on the line of \( U_{1,PA} = n \) cannot be the optimum either, since they are dominated by \( TF = \frac{\sqrt{5}-1}{2} \frac{\Delta^2}{h-l} \) on the line of \( U_{1,PA} = n \). Therefore the optimum must have \( \frac{\sqrt{5}-1}{2} \frac{\Delta^2}{h-l} \geq TF \) and \( U_{1,PA} = n \). But this region is dominated by the intersection of \( TF = \frac{\Delta^2}{h-l} \) and \( U_{1,PA} = 0 \). This is because on any point of the line \( \frac{\sqrt{5}-1}{2} \frac{\Delta^2}{h-l} \geq TF \& U_{1,PA} = n \), the directional derivative of moving down along the line towards the intersection of \( TF = \frac{\Delta^2}{h-l} \) and \( U_{1,PA} = n \) is

\[
\left(-1, \frac{\partial U_{1,PA}}{\partial \Delta}, \frac{\partial SR4}{\partial \Delta}, \frac{\partial SR4}{\partial TF} \right) > 0
\]

So the optimal of \( SR4 \) on the domain of form 3&4 is on \( TF = \frac{\Delta^2}{h-l} \) and \( U_{1,PA} = n \), and it’s in the domain of form 1. Hence form 4 is dominated by form 1.

\[\square\]

\[\text{Need to add proof later. Already have it.}\]

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Finally, we show that releasing the constraint $r_{B2} = m + Z + l$ will not change the result that Form 1 dominates all partial acceptance case. The boundary between full acceptance and partial acceptance is not affected by $r_{B2}$. However, the condition when form 2 happens or form 3&4 happens may change. That is, the seller might reduce $r_{B2}$ from $m + Z + l$ to incentivize bidder 2 to acquire information, such that form 2 takes place less frequently, while form 3&4 happens instead. In addition, the seller might reduce $r_{B2}$ from $Z + l$ to transform some of form 3 into form 4. In regions of form 4 when $r_{B2} = m + Z + l$, the seller won’t raise $r_{B2}$ above $m + Z + l$. This is because even if this won’t deter bidder 2 from acquiring information, the rise in reserve price cannot compensate the loss of gains from trade due to Assumption 2 (as what would happen in a typical auction with only one informed bidder). In addition, if the seller raise $r_{B2}$ even further, additional loss would occur because bidder 2 might not acquire information.

The seller’s revenue as a function of $(\Delta, TF)$ in form 2 and 3 does not depend on $r_{B2}$. Hence the revenue in form 2 and 3 is unchanged under the optimal $r_{B2}$ as compared to that with $r_{B2} = m + Z + l$. This is true even if the domain of form 2 and 3 has changed. Therefore under the optimal $r_{B2}$, form 1 still dominates form 2 and 3 (the proof of Proposition B.2 and B.3 does not depend on the domain except that $TF \leq \frac{\Delta^2}{h-l}$).

The seller’s revenue under form 4, however, is a function of $r_{B2}$. The part relevant is the case with $x_1 < l + \Delta - \frac{TF}{\Delta} (h-l)$. If the seller reduces $r_{B2}$ from $m + Z + l$, then there would be regions which used to be in form 3 transforming into form 4. However, the revenue there is lower than $SR_4$, which assumes $r_{B2} = m + Z + l$. This is because the price collected is lower than $m + Z + l$. Since we’ve shown in Proposition B.4 that $SR_4$ on the domain of form 3 & 4 is dominated by form 1, the revenue in regions transformed from form 3 to 4 is dominated by form 1.

Finally, we can verify that $\Delta < 0$ or $\Delta > h - l$ will be dominated by form 1. The proof is similar to the benchmark case.

Proof. of Proposition 3.6

When $c_V \in [p \frac{h-l}{2}, \frac{1}{p}(1-p)Z - \frac{53}{162}p(h-l)]$, the optimal solution for Form 1 is $(\Delta^*, TF^*) = \left(\frac{3}{5} (h-l), \frac{17}{162} (h-l) + \frac{CV}{p}\right)$. So the seller’s revenue in “go-shop negotiation” is $m + \max(0, p[Z + l + \frac{31}{34} (h-l) - \frac{CV}{p}])$. while the seller’s maximum revenue in auction is $m + \max(0, p \left(Z + \frac{h+l}{2} - \frac{CV}{p}\right))$. Since $p[Z + l + \frac{31}{34} (h-l) - \frac{CV}{p}] = p \left(Z + \frac{h+l}{2} - \frac{CV}{p}\right) + \frac{2p(h-l)}{2p} > p \left(Z + \frac{h+l}{2} - \frac{CV}{p}\right)$, the revenue from the former is weakly higher than the latter, with the equality taken if and only if $\frac{3}{5} p (1-p) Z - \frac{53}{162} p (h-l) \geq c_V \geq \frac{1}{p} (1-p) Z - \frac{53}{162} p (h-l)$.
\( p[Z + l + \frac{31}{54} (h - l)] \).

When \( c_V \in [0, p \frac{h-l}{6}] \), the optimal solution for Form 1 is \((\Delta^*, TF^*) = (0, 0)\). Since bidder 1 with \( V = Z \) accepts the price floor while bidder 1 with \( V = -Z \) is indifferent between acceptance and rejection. Then there exists an equilibrium in which \( V = Z \) accepts and \( V = -Z \) rejects. There also exists other equilibria, but only this equilibrium is the limit of the unique equilibrium under optimal \((b_1, TF, r_{B2})\) when \( U_{1,FA} \to n \) from above. Therefore in the unique equilibrium in Form 1,

\[
\text{Seller's Revenue in "go-shop"} = m + p \left[ (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3 (h - l)^2} \right] \bigg|_{\Delta^* = TF^* = 0} \\
= m + p[Z + l + \frac{h-l}{3}] \\
= \text{Seller's maximum revenue in auction}
\]

When \( c_V \in [p \frac{h-l}{6}, p \frac{h-l}{2}) \), it’s sufficient to show that the optimal revenue in Form 1 is higher than the both the revenues in the asymmetric EQ with \( r = m + Z + l \), and in the mixed-strategy EQ with \( r = m \), as stated in Proposition A.1.

First we show that the revenue \( m + p (Z + l) \) in asymmetric EQ is dominated.

When \( c_V \in [p \frac{h-l}{162/55}, p \frac{h-l}{2}) \), the optimal solution for Form 1 is \((\Delta^*, TF^*) = \left( \frac{2}{3} (h - l), \frac{17}{162} (h - l) + \frac{c_V}{p} \right)\).

\[
\text{Seller’s Revenue in "go-shop"} \quad = m + p \left[ (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3 (h - l)^2} \right] \\
= m + p[Z + l + \frac{31}{54} (h - l) - \frac{c_V}{p}] \\
> m + p[Z + l + \frac{31}{54} (h - l) - \frac{1}{2} (h - l)] \\
= m + p [Z + l]
\]

When \( c_V \in [p \frac{h-l}{6}, p \frac{h-l}{162/55}) \), the optimal solution for Form 1 is \((\Delta^*, TF^*)\), which satisfies \( TF^* = \frac{\Delta^*^2}{h-l}\) and \( \Delta^* \in [0, \frac{2}{3} (h - l)] \).
Since\( \Delta \) derivative with respect to \( c \) at \( c \) to Implicit Function Theorem and Proposition 3.4, the derivative of the optimal seller revenue and \( r \)
\[ \text{Seller's Revenue in "go-shop"} = m + p \left( (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3(h - l)^2} \right) |_{TF^* = \frac{\Delta^*}{h-l}} \]
\[ = m + p(Z + l + \frac{(h - l)^3 - \Delta^3}{3(h - l)^2}) \]
\[ > m + p[Z + l] \]

Next we show that the revenue in form 1 is higher than the that in auction with mixed strategy and \( r = m \) (i.e. \( \frac{3(-2cv + p(h+l+2Z))^2}{4p(h+2l+3Z)} \)). Since the two terms take the same value \( m + p \left( Z + l + \frac{h-l}{3} \right) \) at \( c_V = \frac{p(h-l)}{6} \), it's sufficient to show that both terms decreases in \( c_V \) on \( \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right) \), and that the derivative with respect to \( c_V \) of the former revenue is no greater than that of the latter.

First consider the range of \( c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right) \), where \( TF^* = \frac{\Delta^*}{h-l} \) and \( \Delta^* \in (\frac{2}{3}, \frac{h-l}{3}) \). According to Implicit Function Theorem and Proposition [3.4], the derivative of the optimal seller revenue \( SR^1 \) to \( c_V \) is

\[ \frac{dSR^1}{dc_V} = \frac{dp \left[ m + (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3(h - l)^2} \right] |_{TF^* = \frac{\Delta^*}{h-l}}}{dc_V} \]
\[ = \frac{dp \left( (Z + l + \Delta^* - \frac{\Delta^*}{h-l}) + \frac{(h - l - \Delta^*)^3}{3(h - l)^2} \right)}{dc_V} \]
\[ = \frac{-p \Delta^2 \Delta^* (c_V)}{(h - l)^2} \]
\[ = \frac{-2\Delta^*}{2(h - l) - \Delta^*} \]

Since \( \Delta^* \in (\frac{2}{3}, \frac{h-l}{3}) \) in this region, we have \( \frac{dSR^1}{dc_V} = \frac{-2\Delta^*}{2(h - l) - \Delta^*} < 0 \) and that \( \frac{dSR^1}{dc_V} = \frac{-2\Delta^*}{2(h - l) - \Delta^*} > \frac{-2\frac{2}{3}(h-l)}{2(h - l) - \frac{2}{3}(h-l)} = -1. \)

When \( c_V \in \left[ \frac{p(h-l)}{102/55}, \frac{p(h-l)}{12/55} \right] \), \( SR^1 = m + p[Z + l + \frac{31}{144} (h-l) - \frac{c_V}{p}] \), so \( \frac{dSR^1}{dc_V} = -1. \)

Therefore

\[ 0 > \frac{dSR^1}{dc_V} \geq -1, \forall c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right]. \] (B.8)

On the other hand, the derivative of the revenue in auction with reserve price \( r = 0 \) and mixed strategy
\[ \frac{d}{dc_V} \frac{3(-2c_V+p(h+l+2Z))^2}{4p(h+2l+3Z)} = -\frac{3(-2c_V+p(h+l+2Z))}{p(h+2l+3Z)} \]

The condition that this derivative is below \(-1\) is that
\[ -\frac{3(-2c_V+p(h+l+2Z))}{p(h+2l+3Z)} < -1 \]
\[ \iff c_V < \frac{p(2h+l+3Z)}{6} \]

A sufficient condition for that to hold for all \(c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right] \) is
\[ \frac{p(h-l)}{2} < \frac{p(2h+l+3Z)}{6} \]

which is implied by \(h < 4l + 3Z\). The last condition holds due to Assumption 2. Therefore the derivative of the seller’s revenue in auction with reserve price \(r = m\) and mixed strategy is below \(-1\). Combining with inequality (B.8), we show that the seller’s revenue in go-shop negotiation decreases faster than that in auction with \(r = 0\) and mixed strategy on \(c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right] \), while their values coincide at \(c_V = \frac{p(h-l)}{6}\). Therefore we’ve shown that go-shop negotiation revenue dominates the maximum of auction for all \(c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right] \).

\[ \square \]

**Decomposition of benefits and costs when \(c_V\) are in other regions**

In the main part of the paper, I explain the decomposition of benefits and cost when \(c_V \in (\bar{c}, \frac{p(h-l)}{2}]\). In this section, I explain the decomposition for the rest of the cases.

In the case with a higher \(c_V\), i.e. \(c_V \in (\frac{p(h-l)}{2}, p \left( Z + \frac{1}{2} (h + l) \right)]\), the reserve price \(r < Z + l\), and only one bidder acquires information in an English ascending auction. The revenue difference is then
decomposed as follows:

\[ SR_{go-shop} - SR_{auction} = p \left[ \frac{2}{3} (h - l) - \frac{1}{2} (h - l) \right] \]

\[ + \left[ p \left( \frac{h - l}{2} + Z + l - r \right) - c_V - \left( \frac{h - l}{6} - c_V + \frac{h - l}{6} \right) \right] \]

\[ + \frac{3 \Delta^2 (h - l - \Delta) + (h - l)^3 + \Delta^3}{6 (h - l)^2} \]

\[ - \frac{c_V}{\text{cost reimbursement}} \]

\[ - \frac{p \Delta^3}{6 (h - l)^2} \]

where the only difference from the previous case is that the second term is higher in this case. Mathematically, this is because \( r < Z + l \) here, while \( r = Z + l \) in the previous case. Intuitively, when the information acquisition cost is larger, in the optimal ascending auction mechanism the seller has reduce the reserve price from \( Z + l \), so as to make sure that there is still one bidder acquiring information. In a go-shop negotiation, however, the seller does not have to resort to a low reserve price because both bidders are informed.

In the case with \( c_V > p \left( Z + \frac{1}{2} (h + l) \right) \), and \( c_V \leq \min \{ \frac{53}{102} p (1 - p) Z, \frac{53}{102} p (h - l), p(Z + l + \frac{31}{54} (h - l)) \} \), the reserve price \( r = 0 \), and no one acquires information in the ascending auction. The revenue in ascending auction is 0, while the revenue in a go-shop negotiation is strictly positive. In fact, there is an additional force against a go-shop negotiation, i.e. total information acquisition cost is higher. However a go-shop negotiation is still better because \( c_V \) is capped.

Finally, in the case with smaller \( c_V \) where \( c_V \in \left[ \frac{p(h-l)}{6}, c \right] \), the reserve price \( r = 0 \), and both bidders acquire with probability \( q = 1 - \frac{6c_V - p(h-l)}{2p(h+2l+3Z-3r)} \). The five forces play similar roles as previously, while there is a sixth force going on at the same time. That is, when both bidders acquiring information (occurring with probability \( q^2 \)), a go-shop negotiation improves social surplus by saving the information acquisition cost of one bidder. In fact, a go-shop negotiation cannot enhance social welfare by inducing more competition in this case because the amount of entry stays the same. In the case of one bidder acquiring while the other does not (occurring with probability \( q (1 - q) \)), the decomposition is identical.
to the analysis with \( c_V \in \left( \frac{p(h-l)}{2}, p\left( Z + \frac{1}{2}(h + l) \right) \right) \), the reserve price \( r < Z + l \), and only one bidder acquires information. Finally, when neither acquires information (occurring with probability \((1 - q)^2\)), the same analysis goes through as in the case with \( c_V > p\left( Z + \frac{1}{2}(h + l) \right) \).
C Extensions

Proof of Proposition 4.1

The new version of Form 1 with the ex ante utility of bidder 1 is no less than that of bidder 2. First, the utility of bidder 2 stays in the same format:

\[ U_{2,FA} = \frac{(h - l - \Delta)^3}{6(h - l)^2} + \frac{h - l - \Delta}{h - l}\frac{\Delta}{h - l} - \frac{\Delta^2}{2}. \]

We focus on the case fully revealing V in which bidder 1 accepts \( b_1 \), if \( V = Z \).

\[
\begin{align*}
\max_{\Delta, TF} \quad & SR_{U_1 \geq U_2} = (1 - p) \cdot 0 + p [ P(x_2 < l + \Delta) \mathbb{E}(Z + l + \Delta - TF) \\
& + P(x_2 \geq l + \Delta) P(x_1 \geq l + \Delta) \mathbb{E}(Z + \min(x_1, x_2) - TF|x_1 \geq l + \Delta, x_2 \geq l + \Delta) \\
& + P(x_2 \geq l + \Delta) P(x_1 < l + \Delta) \mathbb{E}(Z + l + \Delta - TF)] \\
= & \quad p \left[ (Z + l + \Delta - TF) + \frac{(h - l - \Delta)^3}{3(h - l)^2} \right]
\end{align*}
\]

s.t.

(a) \( TF \geq 0 \)

(b) \( 0 \leq \Delta \leq h - l \)

(\(-Z \) rejects \( b_1 \))

(c) \( TF \leq \frac{\Delta}{h - l} (2Z - h + l + \Delta) \)

(B1 acq info)

(d) \( U_{1,FA} \geq \mathbb{E}_{x_1} \{ \max \{ 0, TF + \frac{\Delta}{h - l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \} \} \)

(\( \forall x_1 \) accepts if \( V = Z \))

(e) \( TF \geq \frac{\Delta^2}{h - l} \)

(f) \( U_{1,FA} \geq U_{2,FA} \)

(g) \( U_{1,FA} \geq 0 \)

(h) \( U_{2,FA} \geq 0 \)

Note that a sufficient condition for \( (d) \) is

\[
\begin{cases}
TF + \frac{\Delta}{h - l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \leq 0, \forall x_1 \in [l, h] \\
U_{1,FA} \geq \mathbb{E}_{x_1} \{ 0 \} = 0
\end{cases}
\]

\[
\Leftrightarrow \begin{cases}
(d') \quad TF \leq \frac{\Delta}{h - l} (2Z (1 - p) - h + l + \Delta) \\
(f) \quad U_{1,FA} \geq 0
\end{cases}
\]

\[
\frac{\partial SR_{U_1 \geq U_2}}{\partial TF} = -p < 0 \quad \text{and} \quad \frac{\partial SR_{U_1 \geq U_2}}{\partial \Delta} = p \frac{\Delta (2(h - l) - \Delta)}{(h - l)^2} > 0.
\]

Ignore all constraints except \( (f) \), we find the
optimal solution is \((\Delta, TF) = \left(\frac{4}{5} (h - l) \cdot \frac{32}{125} (h - l) + \frac{c_v}{p}\right)\). In order to satisfy \((a), (b), (c), (d'), (e), (g), (h),\) we need \(c_v \in [p \cdot \frac{h-l}{125/4}, p \cdot \frac{50Z(1-p)-13(h-l)}{125/4}]\) (only \(e\) and \(d'\) are binding). From now on we focus on the case with \(c_v < p \cdot \frac{50Z(1-p)-13(h-l)}{125/4}\) to make sure that \((d')\) (then \((d)\)) is true. That is, when bidder 1 is uninformed about \(V\), she does not accept the price floor for all \(x_1\).

When \(c_v \in [0, p \cdot \frac{h-l}{125/4}]\), the we must have \(U_{1,FA} = 0\) and \(TF = \frac{\Delta^2}{h-l}\) at the optimum. To see this, \(U_{1,FA} \geq U_{2,FA}\) is equivalent to \(TF \geq \frac{\Delta^2}{2(h-l)} + \frac{c_v}{p}\). The slope of \(TF = \frac{\Delta^2}{2(h-l)} + \frac{c_v}{p}\) with respect to \(\Delta\) is \(\frac{3\Delta^2}{2(h-l)^2} > 0\), which is smaller than the slope of \(TF = \frac{\Delta^2}{h-l}\) for all \(\Delta \in [0, h-l]\). Therefore on the \((\Delta, TF)\) space with \(TF \geq 0\) and \(\Delta \in [0, h-l]\), if the two lines intersect, \(TF = \frac{\Delta^2}{h-l}\) crosses \(TF = \frac{\Delta^2}{2(h-l)}\) only once and from below. Note that at \(c_v = p \cdot \frac{h-l}{125/4}\), the two lines intersect at \((\Delta, TF) = \left(\frac{4}{5} (h - l) \cdot \frac{32}{125} (h - l) + \frac{c_v}{p}\right)\). When \(c_v\) decreases from \(p \cdot \frac{h-l}{125/4}\), the intersect moves down along \(TF = \frac{\Delta^2}{h-l}\), and reaches \((0,0)\) when \(c_v = 0\). Since the slope of the tangent line to the contour of \(SR_{u_1 \geq u_2}\) is \(\frac{dSR_{u_1 \geq u_2} / d\Delta}{dSR_{u_1 \geq u_2} / dTF} = \frac{\Delta(2(h-l) - \Delta)}{(h-l)^2}\) lies between the slopes of \(TF = \frac{\Delta^2}{2(h-l)} + \frac{c_v}{p}\) and the slope of \(TF = \frac{\Delta^2}{h-l}\) whenever \(0 < \Delta < \frac{4}{5} (h-l)\), the intersection of \(TF = \frac{\Delta^2}{2(h-l)} + \frac{c_v}{p}\) and \(TF = \frac{\Delta^2}{h-l}\) is the optimal solution for \(c_v \in [0, p \cdot \frac{h-l}{125/4}]\). Finally, with \(TF = \frac{\Delta^2}{2(h-l)} + \frac{c_v}{p}\) and \(TF = \frac{\Delta^2}{h-l}\), we know that \(\frac{\Delta^2}{2(h-l)^2} + \frac{c_v}{p} = \frac{\Delta^2}{h-l}\). Note that the solutions when \(c_v \leq p \cdot \frac{h-l}{125/4}\) are indeed optimal, since \(TF = \frac{\Delta^2}{h-l} < \frac{\Delta^2}{h-l} \left(2Z (1-p) - h + l + \Delta\right)\), implying that \((d')\) is true.

Finally, we show that \(\Delta < 0\) or \(\Delta > h-l\) cannot be optimal. \(\square\)

**Lemma C.1.** The optimal seller revenue is decreasing in \(c_v\), and concave in \(c_v\).

**Proof.** When \(c_v \in [p \cdot \frac{h-l}{125/4}, p \cdot \frac{50Z(1-p)-13(h-l)}{125/4}]\),

\[
\frac{d^2SR_{u_1 \geq u_2} (\Delta, TF^*)}{dc_v^2} = \frac{dSR_{u_1 \geq u_2} (\Delta^*, TF^*)}{dc_v} = - \frac{cv + p \cdot \frac{11h + 3d + 3Z}{Z}}{dc_v} = -1 < 0
\]

while \(\frac{d^2SR_{u_1 \geq u_2} (\Delta^*, TF^*)}{dc_v} = \frac{dSR_{u_1 \geq u_2} (\Delta^*, TF^*)}{dc_v} = - \frac{16(h-l)^3}{(4(h-l) - 3\Delta^*)^3 p \Delta} < 0\). \(\square\)

**Proof.** of Proposition 4.2

We compare seller’s revenue in a go-shop negotiation (Proposition 4.1) with the revenue in auction (Proposition A.1).

To start with, Assumption 2 and both \(h\) and \(l\) is positive implies that \(p \cdot \frac{h-l}{125/4} > \bar{c}\), where \(\bar{c}\) is defined as \(\frac{p(h+l+2Z)}{2} - p \cdot \frac{(Z + l)(h + 2l + 3Z)}{3}\).

When \(c_v \in [p \cdot \frac{h-l}{125/4}, p \cdot \frac{50Z(1-p)-13(h-l)}{125/4}]\), the seller’s revenue in a go-shop negotiation is max(0, \(p\) is
\( l + \frac{41}{75} (h - l) - \frac{cV}{p} \)), while that in an English ascending auction is \( \max \left( 0, p \left( Z + \frac{(h+l)}{2} - \frac{cV}{p} \right) \right) \). Since

\[
p \left( Z + \frac{(h+l)}{2} - \frac{cV}{p} \right) = p[Z + l + \frac{41}{75} (h - l) - \frac{7}{75} (h - l)] < p[Z + l + \frac{41}{75} (h - l) - \frac{cV}{p}],
\]

the former is strictly higher than the latter whenever the former is strictly positive, that is, \( cV < p[Z + l + \frac{41}{75} (h - l)] \). Therefore the former strictly dominates the latter when \( cV \in [p \frac{h-l}{2}, \min \{p \frac{50Z(1-p)-13(h-l)}{125/4}, p[Z + l + \frac{41}{75} (h - l)] \}] \).

When \( cV \in [p \frac{h-l}{125/48}, p \frac{h-l}{2}] \), the optimal solution for a go-shop negotiation is \((\Delta^*, TF^*) = \left( \frac{4}{5} (h - l), \frac{32}{125} (h - l) + \right) \).

Seller’s maximum revenue in an English ascending auction is \( p[Z + l] \).

\[
\text{Seller’s Revenue in Go-Shop} = p \left[ (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3(h-l)^2} \right] \\
= p[Z + l + \frac{41}{75} (h - l) - \frac{cV}{p}] \\
> p[Z + l + \frac{41}{75} (h - l) - \frac{1}{2} (h - l)] \\
= p[Z + l]
\]

When \( cV \in [\bar{c}, p \frac{h-l}{125/48}] \), the optimal solution for a go-shop negotiation \((\Delta^*, TF^*) \) satisfies \( TF^* = \frac{\Delta^*^2}{h-l} \) and \( \Delta^* \in [0, \frac{4}{5} (h - l)] \). Seller’s maximum revenue in auction is \( p[Z + l] \).

\[
\text{Seller’s Revenue in Go-Shop} = p \left[ (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3(h-l)^2} \right] |_{TF^* = \frac{\Delta^*^2}{h-l}} \\
= p[Z + l + \frac{(h-l)^3 - \Delta^*^3}{3(h-l)^2}] \\
> p[Z + l]
\]

When \( cV \in (0, p \frac{h-l}{6}) \), the optimal solution for a go-shop negotiation \((\Delta^*, TF^*) \) satisfies \( TF^* = \frac{\Delta^*^2}{h-l} \) and \( \Delta^* \in [0, \frac{4}{5} (h - l)] \). Seller’s maximum revenue in auction is \( p \left[ Z + l + \frac{h-l}{3} \right] \).
Seller’s Revenue in Go-Shop

\[
p \left( \frac{(h - l - \Delta^*)^3}{3(h - l)^2} \right) \bigg|_{TF^* = \frac{\Delta^*}{h-l}}
\]

\[
= p \left[ Z + l + \frac{(h - l)^3 - \Delta^3}{3(h - l)^2} \right]
\]

\[
< p \left[ Z + l + \frac{(h - l)^3}{3(h - l)^2} \right]
\]

\[
= p \left[ Z + l + \frac{h - l}{3} \right]
\]

Note that when \( c_V = 0 \), \((\Delta^*, TF^*) = (0, 0)\), then seller’s revenue in a go-shop negotiation equals to that in an English ascending auction.

Therefore we know that a go-shop negotiation revenue is strictly higher than an English ascending auction revenue when \( c_V = \bar{c} \), while the relation reverses when \( c_V = \frac{p(h-l)}{6} \).

When \( c_V \in \left[ \frac{p(h-l)}{6}, \bar{c} \right) \), the optimal solution for Form 1 \((\Delta^*, TF^*)\) satisfies \( TF^* = \frac{\Delta^2}{h-l} \) and \( \Delta^* \in [0, \frac{4}{5}(h - l)) \). The seller’s maximum revenue in an English ascending auction is

\[
\frac{3(p(h+l+2Z)-2c_V)^2}{4p(h+2l+3Z)}
\]

Due to the continuity of the seller’s revenue in both cases, according to the Intermediate Value Theorem, there exists \( c \in \left( \frac{p(h-l)}{6}, \bar{c} \right) \), such that the two revenues equals at \( c_V = c \). In addition, \( \frac{3(p(h+l+2Z)-2c_V)^2}{4p(h+2l+3Z)} \) is strictly convex in \( c_V \), while according to Lemma [C.1], the seller’s revenue in a go-shop negotiation is strictly concave on \( \left( \frac{p(h-l)}{6}, \bar{c} \right) \). Hence the difference between a go-shop negotiation and an English ascending auction is strictly concave. The strict concavity then implies that \( c < \bar{c} \), a go-shop negotiation is dominated by an English ascending auction, while it is the opposite when \( c > \bar{c} \).

Proof. of Proposition 22.

Let’s consider a separating equilibrium, in which bidder 1 with \( V = Z \) accepts the price floor, while bidder 1 with \( V = -Z \) rejects the price floor and drops out from the game. Note that since it might happen off-equilibrium-path that bidder 1 rejects the price floor but stays in the auction, the seller also need to set a reserve price. Since the only case possible under that scenario is that bidder 1 that \( V = Z \), it is a standard English auction with both bidders knowing their types and without termination fee. Therefore the seller’s optimal reserve price in this case is \( Z + l \) under Assumption 2.
Bidder 2’s incentives won’t change at all compared to the benchmark case, since on equilibrium path bidder 1 still accepts the price floor and stay in the auction if and only if $V = Z$. However, bidder 2’s belief changes off-equilibrium-path. That is, the belief is

$$
\begin{align*}
V &= Z, & &\text{if bidder 1 accepts the price floor (and hence stays in the auction),} \\
&\quad\quad\text{or if bidder 1 rejects the price floor but stays in the auction.} \\
V &= -Z, & &\text{if bidder 1 rejects the price floor and drops from the auction.}
\end{align*}
$$

Therefore, if bidder 1 rejects the price floor and drops from the auction, bidder 2 does not acquire information, and joins the auction bidding $Z + x_2$.

Bidder 1’s incentives to acquire information and to accept the price floor has changed if the seller cannot exclude bidder 1 for rejecting the price floor.

Suppose bidder 1 has acquired information about $V$. He can either accept the price floor (hence committing to stay in the auction and bids at least the price floor), or rejects the price floor. If he rejects the price floor, he could either stay in the fair auction or drops from the auction.

If $V = -Z$, the separating equilibrium requires bidder 1 to reject the price floor and drop from the auction for all $x_1 \in [l, h]$. If accepting the price floor and bid $\hat{b}_1$, he gets the same payoff as in the benchmark model: $TF + \frac{\Delta}{k-1} (-2Z + x_1 - l - \Delta)$. If he rejects the price floor and drops from the fair auction, he gets zero. If he enters the fair English auction, he bids below zero and loses the auction, getting zero. Therefore the condition is still inequality (?)).

If $V = Z$, bidder 1 should accept the price floor for all $x_1 \in [l, h]$. If bidder 1 deviates to rejecting the price floor instead, he prefers to show up in the auction than not to. To see this, if he does not show up, he gets zero. If he shows up, bidder 2 immediately understands that $V = Z$, so bidder 2 does not acquire information, and both bidders enter a fair English auction, knowing their types. Then bidder 1’s expected profit in the auction by such deviation is $\frac{(x_1 - l)^2}{2(h-l)}$, which is weakly higher than zero. Therefore bidder 1’s interim profit by deviating to rejecting the price floor is $\frac{(x_1 - l)^2}{2(h-l)}$.

The payoffs to bidder 1 of accepting the price floor is the same as that in the benchmark model. That is, if $x_1 \geq l + \Delta$, bidder 1 will bid $b_1 = u_1 - TF$ if accepting the price floor. Then bidder 1’s expected
payoff by accepting the price floor is

\[
TF + \mathbb{E}(Z + x_1 - Z - x_2|x_1 \geq x_2, x_2 \geq l + \Delta; x_1 \geq l + \Delta) P(x_1 \geq x_2| x_2 \geq l + \Delta; x_1 \geq l + \Delta) P(x_2 \geq l + \Delta)
\]

\[
+ P(x_2 < l + \Delta) (Z + x_1 - b_1)
\]

\[
= TF + \frac{(x_1 - l - \Delta)^2}{2(h-l)} + \frac{\Delta}{h-l} (x_1 - l - \Delta)
\]

If \(x_1 < l + \Delta\), bidder 1 will bid \(b_1\) if accepting the price floor to minimize losses. Then his payoff in this case is

\[
P(x_2 < l + \Delta) (Z + x_1 - b_1) + (1 - P(x_2 < l + \Delta)) TF
\]

\[
= TF + \frac{\Delta}{h-l} (x_1 - l - \Delta)
\]

Therefore for bidder 1 with \(V = Z\) to accept the price floor, we must have

\[
\begin{cases}
TF + \frac{(x_1 - l - \Delta)^2}{2(h-l)} + \frac{\Delta}{h-l} (x_1 - l - \Delta) \geq \frac{(x_1 - l)^2}{2(h-l)}, & \forall x_1 \in [l + \Delta, h] \\
TF + \frac{\Delta}{h-l} (x_1 - l - \Delta) \geq \frac{(x_1 - l)^2}{2(h-l)}, & \forall x_1 \in [l, l + \Delta]
\end{cases}
\]

\[
\Leftrightarrow TF \geq \frac{\Delta^2}{h-l}
\]

It turns out that the requirement coincides with that in the benchmark model for bidder 1 with \(x_1 \in [l, h]\) and \(V = Z\) to accept the price floor!

Then we consider bidder 1’s incentive to acquire information. If acquiring information, he gets expected payoff \(U_{1,F,A}\). If not acquiring information about \(V\), based on his value \(x_1\), he could either rejects the price floor and drops from the auction, which gives him zero; or he could accepts the price floor, giving him \(TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta)\). Or he could rejects the price floor and stays in the auction. Since bidder 2 does not observe bidder 1’s action of information acquisition, bidder 2 believes \(V = Z\) without information acquisition and bids \(Z + x_2\). Bidder 1’s optimal bidding strategy is to bid his value \(\mathbb{E}(V) + l < 0\) and loses the auction, getting zero. Note that the first two options are the same as in the
benchmark model. So for bidder 1 to acquire information, we need
\[ U_{1,FA} \geq \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \right] \}, \]

which remains to be the same with the condition under the benchmark model.

Finally, bidder 1’s participation constraint is still \( U_{1,FA} \geq 0 \).

Therefore the problem is exactly the same as the Form 1 in the benchmark model. \( \square \)

**Proof of Proposition 4.4**

The seller’s revenue in “a go-shop negotiation” is as follows.
\[
P \left[ Z + \frac{2}{3} (h-l) - \frac{CV}{P} \right] \quad \text{welfare if seller conducts and announces} \quad - \frac{(\Delta^2/3 - \frac{1}{2})}{6(h-l)^2} \Delta \quad \text{distortion} \quad \begin{array}{c} 0 \text{ B1’s rent} \\ \left( h - l - \Delta \right)^2 \text{ B2’s rent} \end{array} \]
\[\quad = P \left[ Z + \frac{2}{3} (h-l) - \frac{CV}{P} \right] \quad \text{welfare if seller conducts and announces} \quad - h - l \quad \text{distortion} \quad \begin{array}{c} 0 \text{ B1’s rent} \\ \frac{h-l}{6} \text{ B2’s rent} \end{array} \]
\[\quad > P \left[ Z + \frac{2}{3} (h-l) - \frac{CV}{P} \right] \quad \text{welfare if seller conducts and announces} \quad - h - l \quad \text{distortion} \quad \begin{array}{c} 0 \text{ B1’s rent} \\ \frac{h-l}{6} \text{ B2’s rent} \end{array} \], \forall \Delta \in [0, h-l]
\[\quad = \text{Seller Revenue (seller conducts due diligence and announces it)} \]

So the inequality holds as long as \((\Delta, TF)\) is such that all the constraints for Form 1 holds and \( U_{1,FA} = 0 \). That is, there exists a solution to Form 1 that dominates the case with seller conducting information acquisition and announcing it before an English Auction with reserve price \( Z + l \) (which is the optimal mechanism if seller announces \( V \) for free). \( \square \)
D  Additional Empirical Evidence

Figure D.1: Frequency of Use by Year: Go-Shop Negotiations/All Mechanisms

Figure D.2: Frequency of Use Year: Go-Shop Negotiations/(Go-Shop Negotiations + Auctions)
Figure D.3: Magnitude of Second Stage Competition: Go-Shop Negotiations vs. No-Shop Negotiations