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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 solicits additional bids publicly during a “go-shop” period. With a theoretical framework, I show that a “go-shop” negotiation generates higher seller revenue than does an auction, when (i) the costs to bidders of learning their valuations are sufficiently high, (ii) the bidders’ valuations are moderately correlated with each other, and (iii) 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: an “ascending auction” and a negotiation with a “go-shop” provision. While the former procedure has historically been more prevalent, “go-shop negotiation” has been increasingly popular since emerged in a private equity deal in 2004.

For an example of a standard auction, consider a 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. Then, the target held an auction in which all interested buyers submitted their bids. Finally, the target signed a merger agreement with one bidder, Laboratory Corporations of America Holdings, which submitted the highest bid $2.4 per share, 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 before the 2006-2008 leveraged buyout boom. An example concerns the sale of CKE Restaurants to a private equity firm Apollo Management. In September of 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 all of them, while excluding the senior management from most of the negotiation process. At the end of the negotiation, the target signed a tentative merger agreement with the highest bidder among the three, Thomas H. Lee Partners. The agreement specified a minimum bid $11.05 per share for that bidder, the target’s right to solicit other bids in a “go-shop” period after announcing the agreement, and a $9.28 million termination fee plus a cost reimbursement capped by $5 million. 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 4 potential strategic buyers, soliciting their interest in making a superior proposal. Among them, a private equity firm Apollo Management topped the original offer with a bid of $12.55 per share, an offer with

1Strategic buyers are usually corporate buyers that look for companies that will create a synergy with their existing businesses.
which Thomas H. Lee was not able to compete. As a result, Apollo won the deal, while the target paid the termination fee and the cost reimbursement 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 auctions have been a traditional selling mechanism, which are used in 36% of M&A deals between 2003 and 2015. A go-shop negotiation, on the other hand, represents a relatively new mechanism. Originated with deals involving private equity buyers, go-shop negotiations 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 use of a go-shop negotiation is also higher in bankruptcy sales under Section 363 of Chapter 11 (84%) than in non-bankruptcy M&As (5%). In addition, it differs across target industries.

The empirical evidence motivates two questions: (1) why are both auctions and go-shop negotiations observed in practice? (2) 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 to favor a particular bidder, which has promised the management a large compensation package. It has also been heavily debated in courts on whether a go-shop negotiation mechanism has fulfilled the Revlon duties that require the target management to

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2 Source of data: MergerMetrics.

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

4 Source 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 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.


6 In 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.

7 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) about litigation risk concerns.
maximize the shareholders’ value.\footnote{See Subramanian (2008)’s 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 the first theory work 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 bribes 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 therefore will improve bidder competition 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 more often to the initial bidder 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 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 \textit{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 are 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 must be 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 becomes informed of the existence of gains from trade for free by learning that the first bidder’s value is sufficiently high. This 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.

However, if 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 very low profit from the second stage auction, the second bidder will not enter the game even

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11 Source of data: SDC.
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 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).
knowing there are gains from trade.

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 (1) go-shop negotiations are driven by a bidder with strong bargaining power, and (2) 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 might 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 the first formal model that captures the institutional features of go-shop negotiations observed in practice. Still, the paper is related to the literature on sequential negotiations featuring preemptive bidding, including Fishman (1988), Bulow and Klemperer (2009), and 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 synergy *shared* by both bidders. Therefore, preferential treatment such as termination fees are essential to incentivizing 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 to bid above a certain threshold, without revealing the actual bid. This assumption makes preemptive bidding less of a concern, and allows me to focus 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. 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) considers 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 underpricing 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 is different for the following reasons. First, IPO underpricing models involves both the primary market and the secondary market, while my model involves only the primary market. Second, all investors’ values on the issued equity are identical, while in my model it is essential that the bidders’ values are not perfectly correlated. Third, primary dealers who care about their reputation are willing to provide high quality information. In my model, however, the first bidder would like to avoid revealing the existence of gains from trade, so as to minimize second stage competition.

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 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 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 theory works on correlated information such as Cremer and McLean (1985) and (1988). However, my model assumes limited liability for both potential bidders, therefore the full extractions of bidders’ rents in Cremer and McLean’s papers are not possible.

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 this literature and my paper, 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 is about information acquisition. The nature of such effort leads to implications regarding information revelation and correlation of bidder values, which were not present in the literature of exclusivity.

Other related theory works include multi-stage auctions such as Ye (2006), 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” might benefit the seller compared to the 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) that compares multi-bidder takeover deals to single-bidder takeover deals, Boone and Mulherin (2007a) and Burch (2001) about termination fees and other deal protections, and Gilson, Hotchkiss and Osborn (2015) about “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 thought of as the stock market capitalization. The bidders’ stand-alone values if there is no trade with the seller are both $n$. The values of the outside options are common knowledge. Bidder $i$’s value for the target firms is

$$W_i = m + x_i + V, \ i = 1, 2$$

Therefore, the synergy between bidder $i$ and the target is

$$u_i = V + x_i, \ i = 1, 2$$

where the common part of the synergy is

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

with $Z > 0$. This part is due to the common expertise among the two bidders. The idiosyncratic synergy of bidder $i$ is $x_i \sim U [l, h]$, i.i.d., and is also independent to the common synergy $V$.

I make the following assumptions for the valuations.

**Assumption 1.** (common synergy as 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) $\mathbb{E}(V) + x_i < 0$, $\forall x_i \in [l, h]$. 
Assumption 1 implies that the variation of the common part dwarfs that of the idiosyncratic part, so the common synergy is the indicator of 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 synergy reaches the highest value possible. That is, if a potential bidder neither pays the cost to acquire the information of the common synergy 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 $i$ can learn about $V$ perfectly;
- Then, if paying a cost $c_{x_i}$, bidder $i$ can learn about $x_i$ perfectly, 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)* $c_V > 0$, $c_{x_i} = 0$.

Assumption 3 states that the cost of information acquisition on the common part of the synergy is significant, while the idiosyncratic part of the synergy 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 synergy takes place before that of the idiosyncratic part of synergy for tractability.

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 synergy $x_i$ is always learned\(^{13}\) and there is no additional logistic bidding cost. The information acquisition cost $c_V$ is then equivalent to the entry cost.

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

I now make formal characterizations of the ascending auction and go-shop negotiation mechanisms by specifying their timelines.

**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 auction (ascending auction) with reserve price $r$.

**A go-shop negotiation**

- $t = 0$, the seller optimally chooses the triplet $(\bar{b}_1, TF, r_{B2})$ (will be defined in the timeline), 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.

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\(^{13}\) Hence, there would be no contingent information acquisition on the common part of synergy based on the value of $x_i$. These assumptions allow me to focus on the information acquisition of the common part of the synergy, while avoiding analyzing the interaction between the information acquisition about the common part and the private part.

\(^{14}\) For this reason, in my model, a high first bid does not deter entry by the second bidder.
The seller optimally chooses reserve price \( r \), announces it and commits to it. The seller invites both bidders for information acquisition. Each bidder \( i \) first decides on learning \( V \), then learns \( x_i \) regardless. The seller holds an English auction (ascending auction) with reserve price \( r \).

Figure 2.1: Timeline: An English Ascending Auction

- \( t = 1.5 \), the seller asks if bidder 1 is willing to join the English auction happening at the final date and bid at least \( b_1 \), in exchange for 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 is not excluded, the two bidders begin an English auction (ascending auction) with a reserve price \( b_1 \) and a termination fee \( TF \) to bidder 1; otherwise, the seller sets a reserve price \( r_{B2} \) for an English auction with only bidder 2.

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.

Note that I assume the auctions to be English ascending auctions. In such auctions, the price continuously increases beginning with the reserve price. A bidder drops out from the auction if the price exceeds the bidder’s willingness to pay. If, after a bidder has dropped out, there is only one bidder left, then the only bidder that remains wins and pays the price at which the previous bidder dropped out. If all except one bidder drop out as soon as the price exceeds the reserve price, the remaining bidder wins and pays the reserve price. 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
The seller optimally chooses \((b_3, TF, r_{b_2})\), announces them and commits to them. Bidder 1 first decides on learning \(V\), then learns \(x_1\) regardless.

The seller asks if bidder 1 accepts to bid at least \(b_1\), in exchange for a termination fee \(TF\). Yes: bidder 1 gets \(V\) if not winning; No: bidder 1 is excluded.

The seller holds an English auction (ascending auction). Reserve price: if bidder 1 accepts: \(b_3\); if bidder 1 rejects: \(r_{b_2}\).

The seller invites bidder 1 for information acquisition. The seller then invites bidder 2 for information acquisition regardless.

The seller announces bidder 1’s decision. The seller then invites bidder 2 for information acquisition regardless.

Figure 2.2: Timeline: Go-Shop Negotiation

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 6.** *If the second bidder wins, the target reduces the firm value by the amount of the termination fee and pays that amount to the initial bidder, before delivering the firm to the second bidder.*

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. Section 4.5.4 shows that if instead of Assumption 6, we assume the seller pays the termination fee out of the proceeds collected from the second bidder, all results remained to be the same.

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\[^{15}\text{This view is shared by Gorbenko and Malenko (2014), who furthermore point out the complicated nature of the format of auctions used in mergers and acquisitions. Therefore, an English auction is only a reasonable approximation of the auction format observed in practice.}\]
3 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. By choosing an ascending auction, the seller optimizes over the reserve price $r$; by 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.

3.2 Seller’s Optimal Revenue in a Standard English Ascending Auction

Proposition 3.1 summarizes the seller’s optimal revenue and 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 $c_V \in [0, \frac{p(h-l)}{6}]$, both bidders acquire information. The seller’s revenue is $m + p \left( Z + l + \frac{h-l}{3} \right)$.
2. when $c_V \in (\frac{p(h-l)}{6}, \bar{c}]$, both bidders acquire information with probability $1 - \frac{6c_V - p(h-l)}{2p(h+l+3Z)} \in (0,1)$. The seller’s revenue is $m + \frac{3(p(h+l+2Z)-2c_V)^2}{4p(h+l+3Z)}$.
3. when $c_V \in (\bar{c}, \frac{p(h-l)}{2}]$, only one bidder acquires information. The seller’s revenue is $m + p(Z + l)$.
4. when $c_V \in (\frac{p(h-l)}{2}, p(Z + l) + \frac{p}{2} (h - l)]$, only one bidder acquires. The seller’s revenue is $m + p \left( Z + \frac{1}{2} (h + l) \right) - c_V$.
5. when $c_V \in (p(Z + l) + \frac{p}{2} (h - l), +\infty)$, no one acquires information. The seller’s revenue is $m$.

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

Denote $c^*(p(h-l)) = \frac{p(h-l)}{6}$, and $c^{**}(p(h-l), p(Z + l)) = p(Z + l) + \frac{1}{2}p(h - l)$, we have Figure 3.1 summarizing the extent of entry (number of bidders informed of $V$).
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 synergy, $p(Z + l)$. The second part consists of the information rent due to the uncertainty in the private part of the synergy, 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 of ascending auction has the problem of insufficient entry.

3.3 Seller’s Optimal Revenue in go-shop negotiations

From the discussion on an English ascending auction, we know that, when $c_V$ is large, there might be insufficient information acquisition about the existence of gains from trade, and hence, there would be insufficient entry. With a go-shop negotiation in the form of a sequential 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\(^\text{15}\)

\(^{15}\)For tractability, I restrict attention to go-shop negotiation mechanisms that induce a pure-strategy equilibrium of information acquisition. Focusing optimization on this category may not be as restrictive as it may seem. It is possible that the optimal go-shop negotiation mechanism must induce bidder 1 to acquire information, and bidder 1 accepts $b_1$ only if $V = Z$, as long as the cost of information acquisition is too large. Intuitively, this is because (1) it is not profitable for the seller to have at most one bidder informed when it is possible to make both bidders informed, and (2) there is no point in retaining bidder 1 if $V = -Z$. 

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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 all potential types of equilibrium to implement, as long as the cost $c_V$ is in a reasonable range.

**Incentive Compatible Problems in go-shop negotiations**

Before deriving the optimal go-shop negotiation step-by-step, it is helpful to discuss the key difficulties regarding implementing the equilibrium above. First, the seller needs to incentivize bidder 1 to acquire information and provide information externality. There is a hold-up problem, because information acquisition is not contractable. The solution is to compensation bidder 1 for info acquisition with termination fee $TF$, conditional on the first bid is high enough (higher than $b_1$), because a high willingness to pay 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 $b_1$). 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, such that accepting it implies some chance of winning.

Next, we will derive the optimal go-shop negotiation mechanism.

### 3.3.1 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 $c_V \leq \min\left\{ \frac{4}{3} p (1 - p) Z - \frac{53}{162} p (h - l), p(Z + l + \frac{31}{54} (h - l)) \right\}$. 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

$$b_1 = \begin{cases} 
  m + Z + x_1 - TF & \text{if } x_1 \geq b_1 + TF - Z - m \\
  m + b_1 & \text{if } x_1 < b_1 + TF - Z - m 
\end{cases}$$

(iii) Bidder 2 learns $V$ from bidder 1’s action and therefore does not acquire information about $V$. Bidder 2 believes that $V = Z$ iff bidder 1 accepts the price floor $b_1$. Bidder 2’s price at which to drop out is $m + \hat{V} + x_2 - TF$ 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 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 $(b_1, TF, r_{B_2})$.

Using backward induction, I solve the optimal go-shop negotiation mechanism fully revealing $V$. 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 from the game because $V = -Z$ is revealed. The lemma below\footnote{Here is a proof of the lemma. In the English auction, bidder 1 makes the first bid $b_1$. If at $b_1$, bidder 2 decides to drop out, and bidder 1 therefore wins, paying $b_1$. If bidder 2 is able to top $b_1$, each bidder $i$ continues to top the opponent’s bid until the price level reaches the threshold of dropping out, which is $b_i$. 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, 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 $b_2 < b_1$; then, bidder 1 drops out at $b_1$ because dropping out at any level strictly higher than $b_1$ weakly increases the chance of winning for bidder 1 and weakly increases the price to pay for $b_1$. Since $m + u_1 - TF < b_1$, winning and paying $b_1$ already gives bidder 1 negative profit, not to mention if the price of 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 $m + u_1 - TF \geq b_1$. Then, following the standard argument with a typical English auction, dropping out at the net value of winning $m + u_1 - TF$ is the dominant strategy for bidder 1. Second, we consider bidder 2’s dominant strategy to drop out. The standard argument in a typical English auction leads to the same conclusion that $b_2 = m + u_2 - TF$.} derives the equilibrium of the continuation game in the English auction at $t = 2$ if bidder 1 accepts the price floor $b_1$.

**Lemma 3.1.** Suppose that both bidders know $V$ perfectly and that, in an English auction, the seller has already set a reserve price $b_1$ and bidder 1 has agreed to bid at least $b_1$ for all $x_1 \in [l, h]$. In addition,
suppose that the seller commits to pay $TF$ to bidder 1 if bidder 1 loses. Then it is a weakly dominant strategy for bidder 1 and bidder 2 to drop out at

\[
b_1 = m + \max (u_1 - TF, b_{11}), \text{ and } b_2 = m + u_2 - TF
\]

respectively, where $u_i = V + x_i, \forall i = 1, 2$ is the synergy between bidder $i$ and the target.

Note that $m + u_i - TF, i = 1, 2$ are the bidder $i$'s valuation of the firm if winning the auction, net of the profit if losing because, for bidder 1, winning gives $n + m + u_1$, while losing gives $n + TF$; for bidder 2, winning gives $n + m + u_2 - TF$ because $TF$ is paid out of the value of the firm according to Assumption 6, while losing leads to outside option $n$.

Termination fee $TF$ and price floor $b_1$ together determine the allocation distortion in favor of bidder 1 (i.e. the target firm is inefficiently assigned to bidder 1 more often), and the transfer from the seller to bidder 1. In particular, if $b_1$ increases while fixing $TF$, it is harder for bidder 2 to top the first bid $b_1$. However, $b_1$, which is the price that bidder 1 has to pay to the seller if bidder 2 does not top the first bid, would be higher too. Therefore, there is more allocation distortion in favor of bidder 1, but less transfer from the seller to bidder 1. On the other hand, if $TF$ increases while fixing $b_1$, it is also harder for bidder 2 to top the first bid when taking into account of a higher $TF$. Moreover, if bidder 2 is able to top the first bid $b_{11}$, bidder 2's bid in the second stage would decrease by the amount by which $TF$ increases; then, bidder 1 has to pay less if winning over bidder 2 in this case. Therefore, the target’s firm is also inefficiently assigned to bidder 1 more often, and the transfer from the seller to bidder 1 is higher.

Since allocation distortion is affected by both $TF$ and $b_1$, I will define a new variable to isolate the force affecting allocation inefficiency. In particular, I define $\Delta$ as

\[
\Delta = b_1 - (m + Z + l - TF).
\]

That is, if $V = Z$ is revealed to both bidders, $\Delta$ is the difference between bidder 1’s promised minimum bid $b_1$ and bidder 2’s minimum price to drop out in the second-stage auction. This term measures how difficult it is for bidder 2 to top the first bid $b_{11}$, because the probability of the first bid $b_{11}$ being topped is $\Pr (x_2 > \Delta) = 1 - \frac{\Delta}{l - l}$. 

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The allocation rule of the game if $V = Z$ is uniquely determined by $\Delta$, according to Lemma 3.2 below.

**Lemma 3.2.** Consider the equilibrium described in Lemma 3.1 and consider the case with $V = Z$.

If $\Delta \in [0, h - l]$ so that $l + \Delta \in [l, h]$.

(i) if $x_1 \geq l + \Delta$, or if $x_1 < l + \Delta$ and $x_2 \geq l + \Delta$, bidder $i$ wins if and only if $x_i \geq x_{-i}$.

(ii) if $x_1 < l + \Delta$ and $x_2 < l + \Delta$, bidder 1 always wins.

If $\Delta \leq 0$, there is no distortion; if $\Delta > h - l$, bidder 1 always wins.

A direct implication of Lemma 3.2 is Proposition 3.3.

**Proposition 3.3.** ($\Delta$ pins down allocation distortion, $TF$ determines transfer)

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

(ii) The termination fee $TF$ is only a transfer from the seller to bidder 1 and does not create distortion.

In the case of $V = Z$, Figure 3.2 summarizes the bidding strategy of both bidders characterized in Lemma 3.1 and the distortion of allocation in Proposition 3.3. The arrows demonstrate the bidding strategies. The parts marked by bold red segments capture the scenario where there exists allocation distortion. That is, when $x_1 < l + \Delta$ and $x_2 < l + \Delta$, bidder 1 always wins the target firm, regardless of how $x_1$ is compared to $x_2$. For the rest of the cases, the target firm is allocated efficiently.

Now that we know the bidding strategy of both bidders, we are ready to prove Proposition 3.2 by looking at incentive-compatible conditions and individual rationality conditions. First, we check if bidder

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18 A higher $\Delta$ while fixing $TF$ also implies a lower transfer from the seller to the bidder 1, because $b_1$ is higher.
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

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

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

$$\Leftrightarrow TF < \frac{\Delta}{h-l} (2Z - h + l + \Delta). \quad (3.1)$$

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

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

$$+ P(x_1 < x_2|x_2 \geq l + \Delta) (n + TF))$$

$$+ P(x_2 < l + \Delta) (n + m + Z + x_1 - b_1)$$

$$= n + TF + \frac{(x_1 - l - \Delta)^2}{2(h-l)} + \frac{\Delta}{h-l} (x_1 - l - \Delta) \geq U, \forall TF \geq 0, \forall x_1 \in [l + \Delta, h]$$

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

\[
TF \geq \frac{\Delta^2}{h-l}. \tag{3.2}
\]

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 synergy is negative for all \( x_1 \) according to Assumption 2. Therefore, he gets

\[
P( x_2 < l + \Delta ) ( n + m + Z + x_1 - b_1 ) + (1 - P( x_2 < l + \Delta )) ( n + TF ) \\
= n + \frac{\Delta}{h-l} ( Zp + (1-p)(-Z) + x_1 - Z - l - \Delta + TF ) + \frac{h-l-\Delta}{h-l} TF \\
= n + TF + \frac{\Delta}{h-l} (-2Z(1-p) + x_1 - l - \Delta) \tag{3.3}
\]

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

$$U_1 = -c_V + n + p \cdot P(x_2 \geq l + \Delta) \cdot \{P(x_1 \leq x_2 | x_1, x_2 \geq l + \Delta) \cdot (TF + \Delta \cdot \mathbf{E}(x_1 + Z - Z - x_2 + TF| x_1 \geq x_2, x_1, x_2 \geq l + \Delta))
+ p \cdot P(x_2 < l + \Delta) \cdot \mathbf{E}(x_1 + Z - Z - l - \Delta + TF| x_2 < l + \Delta)
+ p \cdot P(x_2 \geq l + \Delta) \cdot P(x_1 < l + \Delta) \cdot TF\} \cdot \frac{(h - l - \Delta)^3}{6(h - l)^2} + \frac{\Delta}{h - l} \left(\frac{l + h}{2} - l - \Delta\right).$$

Hence, for bidder 1 to acquire information, we need

$$U_1 \geq n + \mathbb{E}_{x_1}\{\max\{0, TF + \frac{\Delta}{h - l} (-2Z(1 - p) + x_1 - l - \Delta)\}\}. \tag{3.4}$$

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

$$U_1 \geq n. \tag{3.5}$$

Combine the conditions (3.1) to (3.5), recall that Assumption 4 leads to $TF \geq 0$, and assume that $0 \leq \Delta \leq h - l$.\footnote{Will be verified in the Appendix.} We can then write down the conditions for a go-shop negotiation to induce a separating equilibrium fully revealing $V$, and the problem of the seller’s optimization of revenue under those
conditions.

\[
\begin{align*}
\max_{\Delta, TF} & \quad (1 - p) \cdot m + p[P(x_2 < l + \Delta) (m + Z + l + \Delta - TF) \\
& + P(x_2 \geq l + \Delta) P(x_1 \geq l + \Delta) \mathbb{E}(m + Z + \min(x_1, x_2) - TF | x_1, x_2 \geq l + \Delta) \\
& + P(x_2 \geq l + \Delta) P(x_1 < l + \Delta) (m + Z + l + \Delta - TF)] \\
= m + p \left[ (Z + l + \Delta - TF) + \frac{(h - l - \Delta)^3}{3(h - l)^2} \right] \text{ price floor } b_1, \\
\end{align*}
\]

s.t.  
(a) \quad TF \geq 0, \text{ (Assumption 4)}

(b) \quad 0 \leq \Delta \leq h - l, \text{ (restrictions, will be verified later)}

(c) \quad TF \leq \frac{\Delta}{h - l} (2Z - h + l + \Delta), \text{ (type } V = -Z \text{ rejects } b_1) \)

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

(e) \quad TF \geq \frac{\Delta^2}{h - l}, \text{ (V is fully revealed: } \forall x_1 \text{ accepts if } V = Z) \)

(f) \quad U_{1,F_A} \geq n, \text{ (Bidder 1 participates)} \quad (3.6)

In the case with \( V = -Z \), bidder 1 is excluded from the game. Therefore, bidder 2 would also bid below \( m \), and the seller is indifferent between any \( r_{B2} \geq m \). Let the optimal \( r_{B2} = m + Z + l \).

Solving the problem above 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 \( c_V < \min \{ \frac{4}{3} p (1 - p) Z - \frac{53}{162} p (h - l), p(Z + l + \frac{31}{36} (h - l)) \} \), 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 \((b_1, TF, r_{B2})\) 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 \( c_V \in \left[ p \frac{h - l}{162/36}, \min \{ \frac{4}{3} p (1 - p) Z - \frac{53}{162} p (h - l), p(Z + l + \frac{31}{36} (h - l)) \} \} \), then

\[
(\Delta, TF) = \left( \frac{2}{3} (h - l), \frac{17}{162} (h - l) + \frac{c_V}{p} \right).
\]
Bidder 1 acquires info, and accepts price floor iff $V = Z$.
Bidder 2 learns $V$ from bidder 1.

Figure 3.3: Bidder Entry in Go-Shop Negotiations

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

$$c_V = -p \left[\Delta^3 - (h - l)^3 - 3\Delta^2 (h - l)\right] / 6 (h - l)^2$$

and that it is strictly increasing in $c_V$.

$TF$ satisfies

$$TF = \Delta^2 / (h - l)^2.$$ 

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

$$(\Delta, TF) = (0, 0).$$ 

Denote $c^{***} (p (Z + l), p (h - l), p, Z) = \min\{\frac{1}{3} p (1 - p) Z - \frac{53}{162} p (h - l), p (Z + l + \frac{31}{54} (h - l))\}$. Then, similar to Figure 3.1, Figure 3.3 summarizes the level of entry for bidders in go-shop negotiations. Comparison of the two figures show that go-shop negotiations create higher entry for a wide range of $c_V$.

### 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 all types of equilibria.

**Proposition 3.5.** The optimal go-shop negotiation mechanism is stated in Proposition 3.4.
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.** Restrict attention to $c_V$ such that $0 \leq c_V \leq c^{***}(p(Z + l), p(h - l), p, Z)$.

(i) If $c_V$ is large enough, i.e., $c_V > c^*(p(h - l))$, the seller’s revenue in the optimal go-shop negotiation mechanism is strictly higher than that in the optimal ascending auction.

(ii) If $c_V$ is small enough, i.e., $c_V \leq c^*(p(h - l))$, the optimal go-shop negotiation mechanism achieves the same revenue as in the optimal ascending auction.

Moreover, go-shop negotiations can create higher revenue for the seller in go-shop negotiation than in the optimal ascending auction if and only if it increases bidder entry.

The result is intuitive. Go-shop negotiations improve the seller’s revenue because they increase entry. Recall Figure 3.1 and 3.3 that show the level of entry in the two mechanisms. When $c_V$ 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 $c_V$ is large enough but not unreasonably high, go-shop negotiations induce full entry, while English ascending auctions induce at most partial entry, so the revenue from go-shop negotiations is strictly higher.

Figure 3.4 summarizes the key results of the revenue comparison.

3.5.1 The Trade-offs between a go-shop negotiation and an ascending auction

Whenever the revenue in the optimal go-shop negotiation is higher than that of the optimal ascending auction, the difference can be decomposes into the forces in favor of and against go-shop negotiation 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
  3. \((\Delta, TF)\) as a rent extracting device (reserve price and negative entry fee) to further reduce the rent of bidders

- **Costs:**

  1. Seller compensate bidder 1 for information acquisition cost using \(TF\)
  2. Distortion of allocation caused by \(\Delta > 0\)

Before looking at how these forces interact closely, 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 provides a rent extracting device. Therefore \((\Delta, TF)\) is a double-edged sword.

I start with 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.

(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 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 generates higher seller’s revenue.

**Intuition of Proposition 3.7**

When there is insufficient entry in an ascending auction, it’s 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 strictly positive too. 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 $\frac{a_1}{Z}$ in the English 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 role of $(\Delta, TF)$ as costs to the seller is just one side of the coin. In particular, the optimal $\Delta$ in Proposition 3.4 is higher than what 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 termination fee is often higher than the reimbursement of information acquisition cost\(^{20}\).

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 (3.6). Note that the seller’s revenue defined in Problem 3.6 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 might be able to

extract both bidders’ rent by setting a high $\Delta$ and reducing both bidders’ rents. This might come at a cost of bidder 1 no longer willing to accept a higher price floor, or even decide not to acquire information all together. It, however, is not a big concern because the seller can increase $TF$ to compensate bidder 1 and avoid the problem.

To 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 synergy $V = \begin{cases} 10, & \text{with probability 0.3} \\ -10, & \text{with probability 0.7} \end{cases}$, private synergy $x_i \in U [1, 2]$, $i = 1, 2$, cost of learning common synergy as % of target stand-alone value: $\frac{cV}{m} = 1\%$. Then I show the values of the following variables for go-shop negotiations, including expected winning bid premium, first bid premium, 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 unconditional probability of the second bidder wins. I then compare them with their counterparts in deals attracting mostly financial buyers\(^{21}\), where a go-shop negotiation is commonly used. As one can see, 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 level of allocation distortion in favor of the first bidder in both the model and in reality, measured by the probability of a following bidder wins (model: 33%, reality: 17%). Such distortion is stronger in reality than that predicted in the model though. 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, $\frac{go\text{-shop} - auction}{go\text{-shop}} = \frac{3.17 - 0}{3.17} = 100\%$.

### 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

\(^{21}\)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:

\[
SR_{go-shop} = p \left[ Z + l + \frac{2}{3}(h - l) \right] - c_V - p \left( \frac{\Delta}{h - l} \right)^2 \Delta \left( \frac{2}{3} - \frac{1}{2} \right) - \left( 0 \right)_{BY's rent} - p \left( \frac{(h - l - \Delta)^3}{6(h - l)^2} + \frac{(h - l - \Delta)}{h - l} \right)_{BY's rent} \\
= p \left[ Z + l + \frac{2}{3}(h - l) \right] - c_V - p \left( \frac{\Delta^3}{6(h - l)^2} \right)_{distortion} \\
- \left\{ \left[ p \left( \frac{h - l}{6} - c_V + p \left( \frac{h - l}{6} \right) \right) + c_V - p \left( \frac{3\Delta^2(h - l - \Delta) + (h - l)^3 + \Delta^3}{6(h - l)^2} \right) \right] \right\}_{total\ rent\ of\ bidders}
\]

where in the second equality I decompose the total rent of bidders into the term \( p \left( \frac{h - l}{6} - c_V + p \left( \frac{h - l}{6} \right) \right) \), plus the information acquisition cost \( c_V \), 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 \( p \left( \frac{h - l}{6} - c_V + p \left( \frac{h - l}{6} \right) \right) = \left( \frac{h - l}{p} - \frac{c_V}{p} + \frac{h - l}{6} \right) \) is the total rent of the two bidders in an English auction, if bidder 1 has acquired information and announces it \textit{for free} to bidder 2. Note that although this scenario never happens here, considering the bidders’ rent in this case is still helpful for separating 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:

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

\[
= P \left( Z + l + \frac{1}{2} (h - l) \right) - CV - \left\{ P \left( Z + l + \frac{1}{2} (h - l) - Z - l \right) - CV \right\} - \frac{0}{0} \text{Bidder 2's rent}
\]

\[
= P \left( Z + l + \frac{1}{2} (h - l) \right) - CV - \left\{ P \left( Z + l + \frac{1}{2} (h - l) - Z - l \right) - CV \right\} - \frac{0}{0} \text{Bidder 2's rent}
\]

Therefore the difference in revenue of a go-shop negotiation and an English ascending auction are

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

\[\text{increase in social surplus with more entry}\]

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

\[\text{reduction in bidder rent with more competition}\]

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

\[\text{extra rent extracted by seller with (\Delta,TF)}\]

\[- CV \text{cost reimbursement}\]

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

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 an English ascending auction.

**Proposition 3.8. (Social Welfare)**

When \( CV < \frac{h - l}{6} \), the social welfare in a go-shop negotiation is higher because it saves information acquisition cost. When \( CV < \frac{h - l}{6} \), 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\(^{22}\). Therefore in this section I impose on the go-shop negotiation a further constraint that the expected profit of being the first bidder has to be no lower than that of being the second. We will see that this further requirement gives go-shop negotiations a disadvantage. As a result, a go-shop negotiation is dominated by an ascending auction when the information acquisition cost \( c_V \) is low. This is complementary to the benchmark result in which a go-shop negotiation weakly dominates an 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 \((b_1, TF, r_{B2})\) 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 below:

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

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

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

(ii) if \( c_V \in (\frac{p(h-l)}{6}, p\frac{h-l}{125/48}) \), then \( \Delta \in (0, \frac{4}{5}(h-l)) \) and is the unique solution for

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

\(^{22}\)If both bidders are willing to take the lead, the seller can choose one by random, so this won’t be a problem.
and it’s strictly increasing in $c_V$.

$TF$ satisfies

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

Also, $U_{1,FA} = U_{2,FA} \in (0, p^{h-l}_6)$.

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. 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 ascending auction when $c_V$ is large enough, while it is dominated by an ascending auction when $c_V$ is small.

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

(i) If $c_V \in (\zeta, \min\{p\frac{50Z(1-p)-13(h-l)}{125/4}, p(Z+l+\frac{41}{75} (h-l))\}]$, the seller’s revenue in the optimal go-shop negotiation mechanism is strictly higher than that in the optimal English ascending auction.

(ii) If $c_V \in (\frac{p(h-l)}{6}, \zeta)$, the seller’s revenue in the optimal go-shop negotiation mechanism is strictly lower than that in the optimal English ascending auction.

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

Figure 4.1 summarizes the result.
4.2 A model with continuous types and more natural assumptions

In the benchmark model with discrete types, under the assumptions that (i) bidders’ values are correlated enough and (ii) 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. Then I will show with numerical example that when the within-deal correlation of bidders’ values is smaller, a go-shop negotiation is dominated by an ascending auction for a smaller range of parameters.

As in the benchmark model, bidder’s synergies are the sum of common part $V$ and private 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 $u_i$:

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

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 private part.

The model is not tractable analytically, so 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 mean of synergy is $\mu_v + \mu_x = -0.5$, where the negative value suggests 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 higher profit than an ascending auction when the
information acquisition cost $c$ is high enough; in addition, a go-shop negotiation loses its advantage when $c$ is low. Like in the benchmark model, this is because when $c$ is high, there is less entry in an 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 ascending auction.

However, equilibrium in the optimal go-shop negotiation is slightly different from that 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 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 synergy $x_2$ at no cost if knowing there exists gains from trade. In the current version, however, obtaining information about the idiosyncratic part of synergy for bidder 2 is costly. That is, it is conducted through paying the cost $c$ and learning $u_i$. 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 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 make entry decrease when $c$ is so low that both bidder acquires information in an ascending auction. Therefore the go-shop negotiation is dominated by the English ascending auction in terms of seller’s revenue in the latter case, while the relation reverses in the former case, as shown in Figure 4.2.

Although this extension differs from the benchmark model in certain aspects, what is shared by the two model is that bidder 1’s acceptance reveals that it is more likely there exists gains from trade. Encouraged by this information, bidder 2 has more incentive to acquire information about the idiosyncratic part of synergy so as to compete with bidder 1. Therefore, entry is improved when it is more likely there is gains from trade. It is this common intuition that generates similar results on how a go-shop negotiation is compared to an English auction in terms of seller’s revenue when the information cost varies.

We have seen that the qualitative results in 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 ascending auction shrinks when the intra-deal bidder value correlation 
\[ \rho = \frac{\sigma^2_e}{\sigma^2_e + \sigma^2_x} \] 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.
The rest of the extensions all base 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 Intra-deal bidder value correlation is too large

Starting with the benchmark model, take $h - l$ to be very small while keep $Z$ unchanged. Then add a small logistic bidding cost.

**Proposition 4.3.** If the $h - l$ is too small compared to the logistic bidding cost, a go-shop negotiation in which bidder 2 participates does not exist. The seller instead implements a no-shop negotiation mechanism in which only bidder 1 participates. The revenue is the same as an English auction in this case.

This proposition implies that if correlation is too high, a go-shop negotiation would be rarely 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.

### 4.4 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.
  - 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 ascending auction and a go-shop negotiation:
  - remains to be the same as in the bench-mark, except that the probability of bidder 2 not being a potential bidder is $\rho \in [0, 1]$. In a go-shop negotiation, whether bidder 1 is a potential bidder is revealed only after bidder 1 has accepted or rejected the price floor $b_1$. 

Proposition 4.4. When $U$ is sufficiently small, the same results in bench-mark holds. 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 auction in this case.

This proposition implies that if bidder’s bargaining power is low (e.g. more potential bidders), a go-shop negotiation could outperform an English auction. If otherwise, a go-shop negotiation would be rarely 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.

4.5 Robustness checks with alternative setting

4.5.1 Seller cannot set a reserve price

Proposition 4.5. If the seller cannot set a reserve price unless with the first bid in a go-shop negotiation, then the difference in seller’s revenue between a go-shop negotiation and an English Auction is even larger than in the bench-mark case.

4.5.2 The seller cannot commit to exclude bidder 1 if bidder 1 rejects the price floor

Suppose in a go-shop negotiation, the seller cannot exclude bidder 1 from the deal if he rejects the price floor. Instead, bidder 1 is allowed to join the English auction with bidder 2 without the termination fee. In addition, bidder 1 is required to decide whether to stay in the auction, and this decision is publicly announced by the seller before bidder 2 acquires information.

The modified time line for the a go-shop negotiation is as follows, where the parts changed are in italic form.

- $t = 0$, the seller announces the $quad (b_1, TF, r_{fair}, r_{B2}) \geq 0$ (will be defined later) and commits to it.

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

- $t = 1.5$, the seller asks if bidder 1 is willing to join the English auction happening at the final date and bid at least $b_1$. If bidder 1 agrees, the seller promises to pay bidder 1 a termination fee $TF$ out of the firm value if bidder 1 loses the deal in the auction. Otherwise, the seller further asks bidder...
1 to decide whether to stay in game. The seller then announces to bidder 2 of bidder 1’s decision on whether to accept the price floor and whether to stay in the auction.

• $t = 2$, the seller invites bidder 2 for information acquisition, the technology of which is specified in Section 2.2. If bidder 1 accepts the price floor $b_1$, the two bidders start an English auction with reserve price $b_1$, and termination fee $TF$ to bidder 1; if bidder 1 rejects the price floor but stays in the game, both bidders start an English auction with reserve price $r_{fair}$; if bidder 1 drops out from the game, then the seller sets a reserve price $r_{B2}$ for an English auction with only bidder 2.

The assumption that bidder 1 has to make a public decision on whether to drop out of the game is important for the existence of a separating equilibrium. This assumption rules out the possibility that bidder 1 with $V = Z$ rejects the price floor and tricks bidder 2 to believe that $V = -Z$, but still shows up in the auction secretly. However, it also makes double deviation possible, since bidder 1 has two chances to reveal his information about $V$. Yet double deviation here is not a problem here. On equilibrium path, the decision whether to stay in the auction is redundant. That is, if bidder 1 accepts the price floor, bidder 1 commits to stay in the game automatically; if bidder rejects the price floor, that’s because $V = -Z$, so bidder 1 won’t stay in the game either. Regarding the off-equilibrium-path, the additional action of whether to stay in the game helps to sustain a separating equilibrium of the first action (accept/reject the price floor).

The following proposition shows that the optimal go-shop negotiation fully revealing $V$ remains the same as that in the benchmark.

**Proposition 4.6.** If the seller cannot exclude bidder 1 for rejecting the price floor, the equilibrium outcome induced by optimal go-shop negotiation fully revealing $V$ is the same as the one in Proposition 3.4.

4.5.3 Compare a go-shop negotiation with the seller conducting information acquisition and announces 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 $c_V$. Then the seller announces the result $V$ for free, effectively eliminating the entry cost by both bidders. Note that in reality the seller may not be able to do that,
since $V$ might be the common expertise among bidders, and only bidders would be able to figure out. In addition, the information about $V$ might be too complicated to be verifiable.

If the seller does that, the optimal mechanism following the announcement is a standard English auction with reserve price $Z + l$ according to standard optimal mechanism design argument. That is, the mechanism should be symmetric.

**Proposition 4.7.** 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.

### 4.5.4 Alternative assumption on how the seller pays termination fee

In the benchmark model, I assume the seller pays the termination fee to bidder 1 out of the value of the firm. Then according to Proposition 3.3, the termination fee is equivalent to a transfer conditional on bidder 1 accepts the price floor. In addition, there would be no distortion due to the termination fee, but there are distortions due to the price floor.

Alternatively, we can assume the seller pays the termination fee $TF$ out of own pocket. Also, in the ensuing English auction, there is also a bias $B$ in the size of $TF$ in favor of bidder 1 in addition to the termination fee. Then would be equivalent to the first case. So we focus on the assumption that the seller pays the termination fee out of the value of the firm. The following proposition indicates that the results do not change.

**Proposition 4.8.** If the seller pays the termination fee out of own pocket, and in the second stage game, bidder 2 has to bid higher bidder 1’s bid plus $TF$ in order to win. Then the equilibrium outcome in the optimal go-shop negotiation remains to be the same as in Proposition 3.4.
5 Empirical Results

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

I use the following two filters provided by MergerMetrics, the definition 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 bidders. Deal defined as “Negotiation” otherwise.

(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 is not allowed 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);
- Auction & Go-shop.

My model has covered the first three mechanisms, which constitute the majority of all mechanisms. In particular, the “no-shop” negotiation mechanism corresponds to a go-shop negotiation with a high termination fee, so that no new bidder 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’ll see more use of go-shop negotiations relative to standard auctions.

The within-deal correlation of bidders’ values corresponds to

\[ \rho = \frac{Var(V)}{Var(V) + Var(x_i)} \]
in my model. Because valuations are not directly observable, I measure the intra-deal correlation among bidders’ values by the intra-deal correlation of bid premium. 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) which was generously provided by the authors. With a Random Effect ANOVA model, I estimate the within-deal correlation of bid premium.

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

To be specific, I show that the within-deal correlation of bid premium 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 (0.81), even if taking into account of 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 7 financial bidders and 2 strategic bidders on average; for a deal won by a strategic bidder, there are 1 financial bidders and 3 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. Then the average within-deal bidder value correlation is higher for deals won by a financial buyer, because such deals mainly attract financial buyers that have very similar business models.

In addition, the within-deal correlation of bid premium also 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 target industry is in Consumer Durables, Non-Durables and Retail Trade is 0.96, which is higher than that of high-tech (0.92), although the difference is less statistically significant compared to the case with financial vs. strategic

\footnote{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 out of the scope of the paper.}

\footnote{See Gorbenko and Malenko (2014), Leslie and Oyer (2008)}
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 auctions is indeed higher in deals with higher within-deal correlation of bid premium. 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 following bidder topping the first bid and the following 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 in cases with more frequent use of go-shop negotiations is not low (17% for deals attracting mostly financial buyer, 33% when target industries are in Consumer Durables, Non-Durables and Retail trade). The probability of the following bidder winning is 12% for deals attracting mostly financial buyer, 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 first bid being topped, the probability of the following bidder winning conditional on the first bid being topped, and the unconditional probability of the following 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 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 power is strong, there would be more use of a go-shop negotiation. On the contrary, the theoretical results in my model show that in markets where 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” negotiation by setting a high termination fee.

The empirical evidence seems to favor the results of this paper. Indeed, I find that when there
Figure 5.1: Intra-Deal of Bid Premium and the Use of Go-Shop Negotiations
are less potential bidders (including deals attracting mostly strategic buyers (11 bidders) compared to financial (24 bidders), and including 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 the result.

5.4 Alternative Hypothesis: agency issue

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

Empirical evidence suggests that the agency issue does exist. First of all, a financial buyer is less likely to replace the old management of the target firm than a strategic buyer. Indeed, anecdotal evidence

25The average number of bidders are also provided by the authors of Gorbenko and Malenko (2014).
Deals won by a strategic buyer (attracting mostly strategic buyers on average)

Deals won by a financial buyer (attracting mostly financial buyers on average)

(a) Financial vs. Strategic

Deals won by a strategic buyer (attracting mostly strategic buyers on average)

Deals won by a financial buyer (attracting mostly financial buyers on average)

(b) By Target Industry

Target industry: High-Tech

Target industry: Consumer Durables, Non-Durables and Retail Trade

Figure 5.3: Alternative Hypothesis: Strong Bidder Bargaining Power
suggests that 69% of target management will be replaced during the holding period of a private equity buyer, which is lower than that of a strategic buyer (95%). Therefore, it is possible that agency issue is stronger with a financial buyer, and that 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 Buyout (MBO) deals where 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 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 probably because the first bid is not revealing 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 post-merger CEO or Chairman or President is from the target, within deals won by a strategic buyer. 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%). The use of “no-shop” negotiation is much higher in these deals (89% vs. 63% in all deals won by strategic). Therefore for strategic deals that are susceptible to agency issue, the first bidder and the target management often use “no-shop” negotiations instead of “go-shop” negotiations.

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

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28 The post-merger management data for deals won by a financial buyer is not available.
29 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).
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 under bankruptcy sales (84% according to Gilson, Hotchkiss and Osborn (2015)) while it is only 5% in non-bankruptcy mergers and acquisitions. There are 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%. The unconditional probability of a new bidder winning is 30%.

6 Conclusion

This paper shows that the seller prefers go-shop negotiations over standard ascending auctions when the correlation of bidders value on seller’s firm is sufficiently large but not too highly correlated, the cost of information acquisition is large, the prior of the existence of gains from trade is pessimistic, and 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. However, the agency conflicts between the target management and the target shareholder is a potential explanation for why go-shop

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30In particular, the bankruptcy sales refer to the sales of all assets under Section 363 of Chapter 11.
negotiations is more often in Management Buyouts, which are only a small fraction of all deals using go-shop negotiations.
References


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.

\[\Box\]
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

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

$$
+ (1-q)p \int_{r-Z}^{h} \frac{x_i + Z - r}{h-l} \, dx_i
$$

$$
-c_V
$$

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.

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

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

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

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

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

$$
\Leftrightarrow -3 (h - l) \left( 2c_V (h - l) - p (h + Z - r)^2 \right) \leq 2p (h + Z - r)^3
$$

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

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

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

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

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.

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

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

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

\[
Z + h - \sqrt{\frac{6cv (h - l)}{p}} > Z + l
\]
\[\Leftrightarrow \quad h - l > \sqrt{\frac{6cv (h - l)}{p}}\]
\[\Leftrightarrow \quad cv < \frac{p (h - l)}{6}
\]

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
lies in \((Z + l, Z + h]\) if and only if

\[
Z + h - \sqrt{\frac{2cv(h-l)}{p}} > Z + l
\]

\[
\iff h - l > \sqrt{\frac{2cv(h-l)}{p}}
\]

\[
\iff cv < \frac{p(h-l)}{2}
\]

while the solution is below \(Z + l\) if \(cv \geq \frac{p(h-l)}{2}\).

Together with the fact that \(\frac{\partial m_1}{\partial r} \leq 0\) whenever \(q_{m1} \leq 1\), we have the following characterization of \(q_{m1}\) as a function of \(r\) on \([Z + l, Z + h]\).

**Lemma A.2.** (1) when \(cv \in (0, \frac{p(h-l)}{6})\), \(q_{m1} \geq 1\) on \(r = Z + l\). Then as \(r\) increases, \(q_{m1}\) first increases above 1, and then decreases and crosses 1 from above at \(r = r_1(cv)\), where \(r_1(cv)\) is the unique solution for

\[
\frac{dr_1(cv)}{dcv} = \frac{(h-l)^2}{(Z+h-r_1(cv))(Z+l-r_1(cv))} < 0,
\]

\[r_1 \left( \frac{p(h-l)}{6} \right) = Z + l \text{ and } r_1(cv) \in [Z + l, Z + h] \text{.} \]

In addition, \(\lim_{cv \to 0} r_1(cv) = 1\). Then it hits 0 at \(r_0(cv) = Z + h - \sqrt{\frac{2cv(h-l)}{p}}\) before \(r\) reaches \(Z + h\). So \(q_{m1} \in (0, 1)\) and mixed-strategy equilibrium exists if and only if \(r \in (r_1(cv), r_0(cv))\).

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

(3) when \(cv \in \left[\frac{p(h-l)}{2}, +\infty\right)\), \(q_{m1} < 0\) 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:

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

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 \( c_V > \frac{p(h-l)}{6} \).

\[
\frac{\partial q_{m2}}{\partial r} = \frac{3(-6c_V + p(h - l))}{2p(h + 2l + 3Z - 3r)^2} < 0 \quad \text{if } c_V > \frac{p(h-l)}{6} \\
\geq 0 \quad \text{if } c_V \leq \frac{p(h-l)}{6}
\]

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 \( q_{ml} \in (0, 1) \) and such mixed-strategy equilibrium exists if and only if \( r \in [0, Z - \frac{c}{p} + \frac{1}{2}(h + l)] \).
Lemma A.5. The seller’s profit in a mixed-strategy acquisition equilibrium with \( r \in [0, Z + l] \) is

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

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

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

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

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

\[ -c_V \] (A.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 \( Z + l < r \leq Z + h \)

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

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

This profit \( > U \) is EQ to the same condition as in the bench-mark 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 \[\text{(A.1)}\] with respect to \( r \) is \( \frac{p(h-l)}{(h-l)^2} - c_V \) 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 \[\text{(A.1)}\] be zero with respect to \( c_V \), we got the same ODE as the one for \( r_1(c_V) \). \( \square \)

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

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

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

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the derivative w.r.t. \( r \)

\[
-2 \frac{(Z + l - r)(Z + h + U - 2r)}{(h - l)^2}
\]

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 bench-mark 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

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

**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

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

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

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

$$-c_V \tag{A.5}$$

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 $\tag{A.5}$ 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 A.11.

**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 A.11.

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

**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

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

**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

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

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

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 $r \in [0, r_3(cV)]$, where $r_3(cV) = Z + \frac{1}{2} (h + l) - \frac{c_V}{p}$.

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

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

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 \( c_V \in \left( \frac{p(h-l)}{6}, \frac{p(h-l+2Z)}{2} - p\sqrt{\frac{(Z+l)(h+2l+3Z)}{3}} \right) \), 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 \( \frac{3(p(h+l+2Z)-2c_V)^2}{4p(h+2l+3Z)} \).

(3) when \( c_V \in \left( \frac{p(h-l+2Z)}{2} - p\sqrt{\frac{(Z+l)(h+2l+3Z)}{3}}, \frac{p(h-l)}{2} \right) \), 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 \( p(Z + l) \).

(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 \( c_V \in \left( p \left( Z + \frac{1}{2} (h + l) \right), +\infty \right) \), 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

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

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 (d) is

$$
\begin{align*}
&\begin{cases}
TF + \frac{\Delta h}{h-l} (E(V) + x_1 - Z - l - \Delta) \leq 0, \forall x_1 \in [l, h] \\
U_{1,FA} \geq n + E_{x_1} \{0\} = n
\end{cases}

\iff
\begin{cases}
(d') & TF \leq \frac{\Delta h}{h-l} (2Z (1-p) - h + l + \Delta) \\
(f) & U_{1,FA} \geq n
\end{cases}
\end{align*}
$$

\[
\frac{\partial SR_1}{\partial TF} = -p < 0 \text{ and } \frac{\partial SR_1}{\partial \Delta} = p \frac{\Delta (2(h-l)-\Delta)}{(h-l)^2} > 0.
\]

Ignore all constraints except constraint (f), 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 (a), (b), (c), (d'), (e), we need $c_V \in \left[p \frac{h-l}{162/55}, \frac{4}{3} p (1-p) Z - \frac{53}{162} p (h-l)\right]$ (only (e) and (d') are binding).

Focus on the case with $c_V < \frac{4}{3} p (1-p) Z - \frac{53}{162} p (h-l)$, where the information acquisition cost not unreasonably large.

When $c_V \in \left[p \frac{h-l}{6}, p \frac{h-l}{162/55}\right)$, 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 $\frac{\Delta (\Delta + 2 (h-l))}{2 (h-l)^2}$, 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 $c_V = p \frac{h-l}{162/55}$, 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 $p \frac{h-l}{162/55}$, the intersect moves down along $TF = \frac{\Delta^2}{h-l}$, and reaches $(0, 0)$ when $c_V = p \frac{h-l}{6}$. Since the slope of the tangent line to the contour of $SR_1$ is $\frac{\partial SR_1}{\partial \Delta} = \frac{\partial SR_1}{\partial TF} = \frac{\Delta (2(h-l)-\Delta)}{(h-l)^2}$ 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 $c_V \in \left[p \frac{h-l}{6}, p \frac{h-l}{162/55}\right)$. Since $\frac{\Delta h}{h-l} (2Z (1-p) - h + l + \Delta) > \frac{\Delta^2}{h-l}$ and at the optimum $TF = \frac{\Delta^2}{h-l}$, so (d') holds. Therefore all constraints are satisfied. Finally, when $c_V \leq p \frac{h-l}{6}$, $TF \geq 0$ 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 $(0, 0)$. 

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Finally, I need to prove that $\Delta < 0$ or $\Delta > h - l$ is not as good as the solution I’ve found.

QED.

Proof of Proposition 3.5

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 $TF < \frac{\Delta^2}{n-1}$.

Assume that the seller’s optimal reserve price is $r_{B2} = m + Z + l$. I’ll show that this assumption does not affect the result later.

If $TF < \frac{\Delta^2}{n-1}$ (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

$$b_1 = \begin{cases} 
  m + Z + x_1 - TF, & x_1 \geq l + \Delta \\
  b_1, & x_1 \in \left[ l + \Delta - TF \frac{h - l}{\Delta}, l + \Delta \right] \\
  N/A (excluded), & x_1 \in \left[ l, l + \Delta - TF \frac{h - l}{\Delta} \right]
\end{cases} \quad (B.1)
$$

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:

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

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

Hence if \(TF < \frac{A^2}{h-l} \), 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 \(E(m + Z + x_2 - r_{B2}) = m + Z + h+l \frac{h-l}{2} - m - Z - l = \frac{h-l}{2} \); with the complementary probability, \(V = -Z \) and bidder 2 gets zero. So bidder 2 acquires information seeing rejection if and only if

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

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 iff \(TF \leq \frac{A^2}{h-l} - \frac{l-p}{2c_V} \).

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

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

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

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

\[
= -c_V + n + \left[ TF \left(1 - \frac{\Delta - TF \frac{h-l}{\Delta}}{h-l}\right) + \frac{(h-l-\Delta)^3}{6(h-l)^2} + \frac{\Delta}{h-l} \left(1 - \frac{\Delta - TF \frac{h-l}{\Delta}}{h-l}\right) \left(l + h + (\Delta - TF \frac{h-l}{\Delta}) \right) \left(l + h + (\Delta - TF \frac{h-l}{\Delta}) \right) \right].
\]

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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.

\[
\begin{align*}
\max_{\Delta, TF} & \quad SR2 = m + (1-p) \cdot 0 + p \{ P(x_2 \geq l + \Delta) P(x_1 \geq l + \Delta) \mathbb{E}(Z + \min(x_1, x_2) - TF | x_1 \geq l + \Delta, x_2 \geq l + \Delta) \\
& \quad + P(x_2 \geq l + \Delta) P \left(x_1 \in \left[ l + \Delta - TF \frac{h-l}{\Delta}, l + \Delta \right] \right) (Z + l + \Delta - TF) \\
& \quad + P(x_2 < l + \Delta) P \left(x_1 \geq l + \Delta - TF \frac{h-l}{\Delta} \right) (Z + l + \Delta - TF) \\
& \quad + P \left(x_1 < l + \Delta - TF \frac{h-l}{\Delta} \right) \cdot 0 \}
\end{align*}
\]

\[
\begin{align*}
= m + p \left[ (Z + l + \Delta - TF) \left( 1 - \frac{\Delta - TF \frac{h-l}{\Delta}}{h-l} \right) + \frac{(h-l-\Delta)^3}{3 (h-l)^2} \right]
\end{align*}
\]

s.t. \( TF \geq 0 \)

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

**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 reduces the probability 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,
\( \frac{\partial U_{1,PA}}{\partial TF} = p \left( 1 - \frac{\Delta}{h-l} + \frac{TF}{h-l} \right) \geq 0 \) 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.

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

\[ \max_{\Delta, TF} \quad SR3 = SR2 = m + p \left[ (Z + l + \Delta - TF) \left( 1 - \frac{\Delta - TF h-l}{h-l} \right) + \frac{(h-l - \Delta)^3}{3(h-l)^2} \right] \]

\[ \text{s.t. } \]

\[ TF \geq 0 \]

\[ 0 \leq \Delta \leq h-l \]

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

\[ U_{1,PA} \geq n + \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \right] \} \]

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

\[ TF \geq \frac{\Delta^2}{h-l} - \frac{1 - p}{p} \frac{\Delta}{2c_V} - 1 \]

\[ U_{1,PA} \geq n \]

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

$$\max_{\Delta, TF} SR4 = m + (1 - p) \cdot 0 + p[P(x_2 \geq l + \Delta) \cdot P(x_1 \geq l + \Delta) \cdot E(Z + \min(x_1, x_2) - TF|x_1 \geq l + \Delta, x_2 \geq l + \Delta)$$

$$+ P(x_2 \geq l + \Delta) \cdot P(x_1 \in [l + \Delta - TF\frac{h-l}{\Delta}, l + \Delta]) (Z + l + \Delta - TF)$$

$$+ P(x_2 < l + \Delta) \cdot P(x_1 \geq l + \Delta - TF\frac{h-l}{\Delta}) (Z + l + \Delta - TF)$$

$$+ P(x_1 < l + \Delta - TF\frac{h-l}{\Delta}) (Z + l)]$$

$$= m + p \left[ (Z + l + \Delta - TF) \left(1 - \frac{\Delta - TF\frac{h-l}{\Delta}}{h-l}\right) + (Z + l) \frac{\Delta - TF\frac{h-l}{\Delta}}{h-l} + \frac{(h-l-\Delta)^3}{3(h-l)^2} \right]$$

s.t. $TF \geq 0$

$0 \leq \Delta \leq h - l$

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

$U_{1,PA} \geq n + E_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h-l} (E(V) + x_1 - Z - l - \Delta) \right] \}$

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

$TF \leq \frac{\Delta^2}{h-l} - \frac{1-p}{p} \frac{\Delta}{2c_V - 1}$

$U_{1,PA} \geq n$

**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

$$\{(\Delta, TF) \in \mathbb{R}^2 \mid TF \geq 0, \quad 0 \leq \Delta \leq h - l, \quad TF \leq \frac{\Delta^2}{h-l}, \quad U_{1,PA} \geq n\}$$
To see this, \( \frac{\partial SR4}{\partial TF} = \frac{\Delta p}{h-l} - \frac{2pTF}{\Delta} \) \> 0 when \( TF < \frac{1}{2} \frac{\Delta^2}{h-l} \) and \( \leq 0 \) when \( TF > \frac{1}{2} \frac{\Delta^2}{h-l} \). \( \frac{\partial SR4}{\partial \Delta} = p \left[ -\frac{\Delta^2}{(h-l)^2} + \frac{TF}{h-l} + \frac{TF^2}{\Delta^2} \right] \leq 0 \) 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 \( \Delta = h-1 \). \(^{31}\) 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:

\[
A = \left\{ (\Delta, TF) \in R^2 \mid \Delta \leq h-l, \right.
\]

\[
\left. TF \leq \frac{\Delta^2}{h-l}, \quad U_{1,PA} \geq n \right\}
\]

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 an 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

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

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. \( \square \)

\(^{31}\)Need to add proof later. Already have it.
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.\(^{32}\)

---

\(^{32}\)Formal proof needed. Should be simple.
$p[Z + l + \frac{31}{54} (h - l)]$.

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 $c_V \in [p\frac{h-l}{102/55}, p\frac{h-l}{2})$, 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 $c_V \in [p\frac{h-l}{102/55}, p\frac{h-l}{2})$, the optimal solution for Form 1 is $(\Delta^*, TF^*) = \left(\frac{2}{3} (h - l), \frac{17}{162} (h - l) + \frac{c_V}{p} \right)$.

$$\text{Seller’s Revenue in ”go-shop”} = m + p \left[ (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3 (h - l)^2} \right]$$

$$= m + p[Z + l + \frac{31}{54} (h - l) - \frac{c_V}{p}]$$

$$> m + p[Z + l + \frac{31}{54} (h - l) - \frac{1}{2} (h - l)]$$

$$= m + p[Z + l]$$

When $c_V \in [p\frac{h-l}{6}, p\frac{h-l}{102/55})$, the optimal solution for Form 1 is $(\Delta^*, TF^*)$, which satisfies $TF^* = \frac{\Delta^*^2}{h-l}$ and $\Delta^* \in [0, \frac{2}{3} (h - l))]$. 

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Since the derivative with respect to $c$ at $c$ to Implicit Function Theorem and Proposition 3.4, the derivative of the optimal seller revenue $r$ is

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

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

$$> m + p(Z + l)$$

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 $c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{102/55} \right)$, where $TF^* = \frac{\Delta^*}{h-l}$ and $\Delta^* \in \left[ 0, \frac{3}{5} (h-l) \right)$. According to Implicit Function Theorem and Proposition 3.4, the derivative of the optimal seller revenue $SR1^*$ to $c_V$ is

$$\frac{dSR1^*}{dc_V} = \frac{dp \left[ m + (Z + l + \Delta^* - TF^*) + \frac{(h-l-\Delta^*)^3}{3(h-l)^2} \right] \bigg|_{TF^* = \frac{\Delta^*}{h-l}}}{dc_V}$$

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

$$= \frac{-p\Delta^2}{(h-l)^2} \frac{d\Delta^* (c_V)}{dc_V}$$

$$= \frac{-2\Delta^*}{2(h-l) - \Delta^*}$$

Since $\Delta^* \in \left[ 0, \frac{3}{5} (h-l) \right)$ in this region, we have $\frac{dSR1^*}{dc_V} = \frac{-2\Delta^*}{2(h-l) - \Delta^*} < 0$ and that $\frac{dSR1^*}{dc_V} = \frac{-2\Delta^*}{2(h-l) - \Delta^*} > \frac{-2\frac{3}{5}(h-l)}{2(h-l) - \frac{3}{5}(h-l)} = -1$.

When $c_V \in \left[ \frac{p(h-l)}{102/55}, \frac{p(h-l)}{2} \right)$, $SR1^* = m + p[Z + l + \frac{31}{14} (h-l) - \frac{cv}{p}]$, so $\frac{dSR1^*}{dc_V} = -1$.

Therefore

$$0 > \frac{dSR1^*}{dc_V} \geq -1, \forall c_V \in \left[ \frac{p(h-l)}{6}, \frac{p(h-l)}{2} \right]. \quad (B.3)$$

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

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.3), 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 \(c_V \in \left[\frac{p(h-l)}{6}, \frac{p(h-l)}{2}\right]\).

\[\Box\]

**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 \(c_V \in (\bar{e}, \frac{p(h-l)}{2}]\). In this section, I explain the decomposition for the rest of the cases.

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

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

\[
\text{increase in social surplus with more entry}
\]

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

\[
\text{reduction in bidder rent with more competition}
\]

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

\[
\text{extra rent extracted by seller with } \Delta, T, F
\]

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

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

\[
\text{distortion}
\]

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 \( c_V > p \left( \frac{1}{2} (Z + h + l) \right) \), and \( c_V \leq \min \left\{ \frac{53}{162} p (1-p) Z, \frac{51}{54} p (h-l) \right\} \), 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:

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

We focus on the case fully revealing V in which bidder 1 accepts \( b_1, \forall x_1 \), if \( V = Z \).

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

\[ s.t. \quad \begin{align*}
(a) & \quad TF \geq 0 \\
(b) & \quad 0 \leq \Delta \leq h - l \\
(c) & \quad TF \leq \frac{\Delta}{h - l} (2Z - h + l + \Delta) \\
(d) & \quad U_{1,FA} \geq \mathbb{E}_{x_1} \{ \max \left[ 0, TF + \frac{\Delta}{h - l} \mathbb{E}(V) + x_1 - Z - l - \Delta \right] \} \\
(e) & \quad TF \geq \frac{\Delta^2}{h - l} \\
(f) & \quad U_{1,FA} \geq U_{2,FA} \\
(g) & \quad U_{1,FA} \geq 0 \\
(h) & \quad U_{2,FA} \geq 0
\end{align*} \]

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

\[
\begin{align*}
& \begin{cases}
TF + \frac{\Delta}{h - l} (\mathbb{E}(V) + x_1 - Z - l - \Delta) \leq 0, \forall x_1 \in [l, h] \\
U_{1,FA} \geq \mathbb{E}_{x_1} \{ 0 \} = 0
\end{cases} \\
\iff \begin{cases}
(d') & \quad TF \leq \frac{\Delta}{h - l} (2Z (1 - p) - h + l + \Delta) \\
(f) & \quad U_{1,FA} \geq 0
\end{cases}
\end{align*}
\]

\[ \frac{\partial SR_{U_1 \geq U_2}}{\partial TF} = -p < 0 \text{ and } \frac{\partial SR_{U_1 \geq U_2}}{\partial \Delta} = p \frac{\Delta (2(h - l) - \Delta)}{(h - l)^2} > 0. \] Ignore all constraints except \( (f) \), we find the
optimal solution is \((\Delta, TF) = \left(\frac{4}{5} (h - l), \frac{32}{125} (h - l) + \frac{c V}{p}\right)\). In order to satisfy \((a), (b), (c), (d'), (e), (g), (h)\), we need \(c V \in [p \frac{h - l}{125/4}, \frac{50Z(1-p) - 13(h-l)}{125/4}]\) (only \((e)\) and \((d')\) are binding). From now on we focus on the case with \(c V < \frac{50Z(1-p) - 13(h-l)}{125/4}\) 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 \(c V \in [0, p \frac{h - l}{125/4}]\), 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 \(TF = \frac{\Delta^2}{2(h-l)} + \frac{c V}{p}\) only once and from below. Note that at \(c V = p \frac{h - l}{125/4}\), the two lines intersect at \((\Delta, TF) = \left(\frac{4}{5} (h - l), \frac{32}{125} (h - l) + \frac{c V}{p}\right)\). When \(c V\) decreases from \(p \frac{h - l}{125/4}\), 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 \(\frac{dSR_{U_1 \geq U_2}}{d\Delta} = \frac{d(2(h-l)-\Delta)}{(h-l)^2}\) 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 \(0 \leq \Delta < \frac{4}{5} (h - l)\), 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 \(c V \in [0, p \frac{h - l}{125/4}]\). Finally, with \(TF = \frac{\Delta^2}{2(h-l)} + \frac{c V}{p}\) and \(TF = \frac{\Delta^2}{h-l}\), we know that \(\frac{\Delta^2}{2(h-l)} + \frac{c V}{p} = \frac{\Delta^2}{h-l}\). Note that the solutions when \(c V \leq p \frac{h - l}{125/4}\) are indeed optimal, since \(TF = \frac{\Delta^2}{h-l} < \frac{\Delta^2}{2(h-l)} (2Z (1 - p) - h + l + \Delta)\), 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 \(c V \in [p \frac{h - l}{125/4}, \frac{50Z(1-p) - 13(h-l)}{125/4}]\), \(\frac{dSR_{U_1 \geq U_2}(\Delta, TF^*)}{dc V} = -c V + p \frac{41h + 3Z + 2\Delta}{125/4} = -1 < 0\), while \(\frac{d^2SR_{U_1 \geq U_2}(\Delta, TF^*)}{d^2c V} = 0\).

When \(c V \in (0, p \frac{h - l}{125/4})\), \(\frac{dSR_{U_1 \geq U_2}(\Delta, TF^*)}{dc V} = \frac{dSR_{U_1 \geq U_2}(\Delta, TF^*)|_{TF^* = \frac{\Delta^2}{h-l}}}{dc V} = \frac{dSR_{U_1 \geq U_2}(\Delta, TF^*)}{d\Delta} \cdot \frac{d\Delta}{dc V} = -\frac{2\Delta^*}{4(h-l)-3\Delta^*} < 0\). Also, \(\frac{d^2SR_{U_1 \geq U_2}(\Delta, TF^*)}{d^2c V} = \frac{d(-\frac{2\Delta^*}{4(h-l)-3\Delta^*})}{dc V} = -\frac{16(h-l)^3}{(4(h-l)-3\Delta^*)^3}p \Delta < 0\). \(\square\)

**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 \(p \frac{h - l}{125/4} > \bar{c}\), where \(\bar{c}\) is defined as \(\frac{p(h+l+2Z)}{2} - \frac{p(h+l+2l+2Z)}{d}\).

When \(c V \in [p \frac{h - l}{125/4}, \frac{50Z(1-p) - 13(h-l)}{125/4}]\), the seller’s revenue in a go-shop negotiation is max\((0, p[Z + l +
\[
\frac{41}{75} (h - l) - \frac{c_V}{p}, \text{ while that in an ascending auction is } \max \left( 0, p \left( Z + \frac{(h+l)}{2} - \frac{c_V}{p} \right) \right). \text{ Since } p \left( Z + \frac{(h+l)}{2} - \frac{c_V}{p} \right) = p[Z + l + \frac{41}{75} (h - l) - \frac{7}{150} (h - l) < p[Z + l + \frac{41}{75} (h - l) - \frac{c_V}{p}], \text{ the former is strictly higher than the latter whenever the former is strictly positive, that is, } c_V < p[Z + l + \frac{41}{75} (h - l)]. \text{ Therefore the former strictly dominates the latter when } c_V \in \left[ p \frac{h-l}{2}, \min \left\{ p \frac{50Z(1-p) - 13(h-l)}{125/4}, p(Z + l + \frac{41}{75} (h - l)) \right\} \right].
\]

When \( c_V \in \left[ \bar{c}, p \frac{h-l}{125/48} \right], \) the optimal solution for in a go-shop negotiation is \( (\Delta^*, TF^*) = \left( \frac{4}{5} (h - l), \frac{32}{125} (h - l) + \frac{c_V}{p} \right) \). Seller’s maximum revenue in an ascending auction is \( p[Z + l] \).

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

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

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

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

\[ \begin{align*}
S_{\text{Revenue}} & = p \left[ (Z + l + \Delta^* - TF^*) + \frac{(h - l - \Delta^*)^3}{3(h - l)^2} \right]_{TF^* = \frac{\Delta^2}{h - l}} \\
& = p[Z + l + \frac{(h - l)^3 - \Delta^3}{3(h - l)^2}] \\
& < p \left[ Z + l + \frac{(h - l)^3}{3(h - l)^2} \right] \\
& = p \left[ Z + l + \frac{h - l}{3} \right]
\end{align*} \]

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

Therefore we know that a go-shop negotiation revenue is strictly higher than an 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 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 \( c \in (\frac{p(h-l)}{6}, \bar{c}) \), 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 \( (\frac{p(h-l)}{6}, \bar{c}) \). Hence the difference between a go-shop negotiation and an ascending auction is strictly concave. The strict concavity then implies that \( c < c \), a go-shop negotiation is dominated by an ascending auction, while it is the opposite when \( c > \bar{c} \).

Proof. of Proposition 4.6.

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

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

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 $b_1$, he gets the same payoff as in the benchmark model: $TF + \frac{\Delta}{h-l}(-2Z + x_1 - l - \Delta)$. 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

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

$$\quad + P(x_2 < l + \Delta)(Z + x_1 - b_1)$$

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

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

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

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

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

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

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 4.7

The seller’s revenue in “a go-shop negotiation” is as follows.

\[
\begin{align*}
p[ & \left( Z + l + \frac{2}{3} (h - l) - \frac{CV}{p} \right) \cdot \text{welfare if seller conducts and announces} \right] - \left( \frac{\Delta}{h - l} \right)^2 \Delta \left( \frac{2}{3} - \frac{1}{2} \right) - \left( \frac{h - l - \Delta}{6 (h - l)^2} \right) \cdot \text{distortion} - \left( \frac{h - l - \Delta}{6 (h - l)^2} \right) \cdot \text{B1’s rent} \right] \\
= & \left( Z + l + \frac{2}{3} (h - l) - \frac{CV}{p} \right) \cdot \text{welfare if seller conducts and announces} \right] - \left( \frac{h - l - \Delta}{6 (h - l)^2} \right) \cdot \text{distortion} - \left( \frac{h - l - \Delta}{6 (h - l)^2} \right) \cdot \text{B1’s rent} \right] \\
> & \left( Z + l + \frac{2}{3} (h - l) - \frac{CV}{p} \right) \cdot \text{welfare if seller conducts and announces} \right] - \left( \frac{h - l - \Delta}{6 (h - l)^2} \right) \cdot \text{distortion} - \left( \frac{h - l - \Delta}{6 (h - l)^2} \right) \cdot \text{B1’s rent} \right] \\
= & \text{Seller Revenue (seller conducts due diligence and announces it)}
\end{align*}
\]

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).

\[ \square \]

Proof of Proposition 4.8

Termination fee payable to bidder 1 in the case of losing the game reduces bidder 1’s willingness to pay from \(u_1\) to \(u_1 - TF\).

If bidder 2 pays the termination fee as in the bench-mark model, bidder 2’s willingness to pay is also reduced by \(TF\), to \(u_2 - TF\). Therefore both bidders are on a level play field again, and there is no distortion of allocation due to \(TF\). \(TF\) is a transfer from the seller to bidder 1, because the price collected by the seller would be reduced by \(TF\), while the rent of bidder 2 is not affected by \(TF\) (since both bidder
2’s valuation and bidder 2’s payment upon winning are reduced by $TF$.\footnote{In a first price auction, still there is no distortion because both values are reduced by $TF$. However, the price collected by the seller might reduce by less than $TF$ since bids do not change one-to-one to the value.}

In the current extension, the seller pays bidder 1 the termination fee out of own pocket. Therefore bidder 2’s willingness to pay remains to be $u_2$, making it easier for bidder 2 to win if the winner is the one with the highest bid. This would create distortion of allocation in favor or bidder 2. To fix this issue, the seller resets the rule of winning to be that bidder 1 wins and pays $b_2 - TF$ if $b_1 + TF \geq b_2$, and bidder 2 wins and pays $b_1 + TF$ if $b_1 + TF < b_2$ (where $b_i$ is bidder $i$’s price level to drop out, $i = 1, 2$). That is, the seller makes it harder for bidder 2 to win in terms of bids by $TF$. Since in an English auction, change in bids is the same as the change in values,\footnote{In First price auction, however, bids change less than the change of value. So letting the seller might choose the winning rule to be $b_1 + B(TF) \geq b_2$, where $B(TF) < TF$.} this rule makes it harder to bidder 2 to win by $TF$ in terms of value too. Therefore such change off-sets the advantage bidder 2 has over bidder 1 due to bidder 1’s lower willingness to pay, resulting the same effect as directly reducing bidder 2’s valuation by $TF$ as in the benchmark model.

The analysis above is considering the case without any price floor or reserve price. When we add reserve price and the fact that bidder 1 has promised to stay until the reserve price, the argument won’t change. Therefore, we achieve exactly the same results as in the bench-mark model.

QED.
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