



Chapter 7.1.2
Book-building

Outline

- Problem and model assumptions
- Efficient pricing
- Bidding process
- Book-building mechanism
- Summary

■ Problem and model assumptions

■ Efficient pricing

■ Bidding process

■ Book-building mechanism

■ Summary

Book-building process

- ▶ Investment banks obtain non-binding bids for a security by selected investors, but bids are expected to be honoured
- ▶ Based on these bids, an offer price range is determined such that all securities can be sold
- ▶ Investors will be reluctant to reveal their positive opinion as it may increase the price they have to pay
- ▶ The allocation of shares can be used to solicit truthful bids

Security value and signals

- ▶ Each of the N investors receives a high (H) or low (L) signal on the value of the security
- ▶ The value of the security V is uniformly distributed on $[\underline{V}; \overline{V}]$, but we normalize this and use $\hat{V} \in [0; 1]$
- ▶ We assume that the a high signal is observed with probability \hat{V} if the security is worth \hat{V} : $Prob(H|\hat{V}) = \hat{V}$
- ▶ Each possible number of high signals is equally likely at $Prob(h) = \frac{1}{N+1}$

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Price setting and issuer proceeds

- ▶ An issuer can sell all Q securities, if at least h^* high signals are received
- ▶ Prices are set such that they reflect the information in the market, h^* high signals:
$$S = E \left[\hat{V} | h^* \right]$$
- ▶ We assume that an issue only goes ahead if all Q securities can be sold at price S
- ▶ Proceeds to issuer: $\Pi_C = Prob(h \geq h^*) E \left[\hat{V} | h^* \right] Q$
- ▶ Using statistics, we get $\Pi_C = \left(1 - \frac{h^*}{N+1} \right) \frac{h^*+1}{N+2} Q$

Optimal price and proceeds

- ▶ Maximizing proceeds gives the optimal threshold h^* as $h^* = \frac{N}{2}$
- ▶ This then gives the offer price as $S = \frac{1}{2}$, which is the expected value
- ▶ Issuer proceeds are then $\Pi_C = \frac{1}{4} \frac{N+2}{N+1} Q \approx \frac{1}{4} Q$
- ▶ The securities are fairly priced, but the issue might not be fully sold and hence be abandoned

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The importance of signals

- ▶ Investors submit bids based on their own signal, but they also infer what information other investors have
- ▶ They can determine the probability that there are a total of h high signals being observed, including their own signal, given they have observed a high or low signal: $Prob(h|H)$ and $Prob(h|L)$
- ▶ Expected value with high signal: $V_H = \sum_{h=1}^N Prob(h-1|H) E[\hat{V}|h] = \frac{2}{3}$
- ▶ Expected value with low signal: $V_L = \sum_{h=0}^{N-1} Prob(h|L) E[\hat{V}|h] = \frac{1}{3}$
- ▶ All investors assess the value of the issue to be either $\frac{1}{3}$ or $\frac{2}{3}$

Ensuring the issue is sold

- ▶ Setting $S \leq \frac{1}{3}$ ensures all securities are sold as every investor makes profit, setting $S < \frac{1}{3}$ would reduce proceeds and not be chosen
- ▶ Setting $S > \frac{2}{3}$ would not sell any securities as all investors value it lower
- ▶ At $S = \frac{2}{3}$, not all securities might be sold if not enough high signals are observed
- ▶ We set $S = \frac{1}{3}$ to ensure the issue is fully sold and the proceeds are $\Pi_C = \frac{1}{3}Q$
- ▶ The price is lower than in efficient pricing, but as all securities are sold, the proceeds are higher

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Bidding process

- ▶ Investors submit bids for securities and once all bids are submitted, a price is determined and securities allocated
- ▶ Bids report whether they claim to have obtained a high or a low signal
- ▶ Allocation can depend on the signal they have reported
- ▶ The aim would be to ensure they report their signal truthfully

Investors with high signal reported truthfully

- ▶ If reporting high signal truthfully and h other high signal have been reported, the value of the security is $E \left[\hat{V} | h + 1 \right]$
- ▶ The offer price will be S_H^h
- ▶ The amount of the security allocated to this investor is Q_H
- ▶ This needs to be weighed for the likelihood of having h high signals, across all possibilities
- ▶ Profits are: $\Pi_D^{HH} = \sum_{h=0}^{N-1} Prob(h|H) \left(E \left[\hat{V} | h + 1 \right] - S_H^h \right) Q_H$

Investor with high signal not reported truthfully

- ▶ If reporting high signal not truthfully and h other high signal have been reported, the value of the security is $E \left[\hat{V} | h + 1 \right]$, unchanged as the investor has the same information
- ▶ The offer price will be S_L^h
- ▶ The amount of the security allocated to this investor is Q_L
- ▶ This needs to be weighed for the likelihood of having h high signals, across all possibilities
- ▶ Profits are: $\Pi_D^{HL} = \sum_{h=0}^{N-1} \text{Prob}(h|H) \left(E \left[\hat{V} | h + 1 \right] - S_L^h \right) Q_L$

Ensuring signals are revealed truthfully

- ▶ An investor receiving a low signal, would not report a high signal as that would increase the expected value and hence the price, reducing his profits
- ▶ An investor receiving a high signal would report it truthfully if $\Pi_D^{HH} \geq \Pi_D^{HL}$
- ▶ If we set $S_H^h < S_L^h$, the issuers receive less proceeds from the issue, optimally we have $S_H^h = S_L^h = S^h$ to maximize proceeds
- ▶ Instead we set $Q_L < Q_H$ to ensure signals are revealed truthfully

Issuer losses

- ▶ Securities issued are held by those with high signals getting Q_H each and low signals getting Q_L each
- ▶ $Q = hQ_H + (N - h)Q_L$
- ▶ Investor profits are identical to losses by the issuer from selling the issue below value
- ▶ $\hat{\Pi}_C = \sum_{h=0}^N \text{Prob}(h) \left(E[\hat{V}|h] - S_h \right) Q$

Minimizing losses

- ▶ These losses can be rewritten as

$$\hat{\Pi}_C = \frac{N}{2} \sum_{h=0}^{N-1} \frac{Prob(h|H)}{N+2} Q$$
$$+ \frac{N}{2} \sum_{h=0}^{N-1} (Prob(h|H) + Prob(h|L)) \left(E[\hat{V}|h] - S_h \right) Q_L$$

- ▶ This is minimized if the second term vanishes
- ▶ Either set $Q_L = 0$ or $S_h = E[\hat{V}|h]$ as the price cannot be set above its value
- ▶ We can set $Q_L = 0$ if investors with high signals could buy the entire issue, otherwise $Q_L > 0$ and the offer price is set at $S_h = E[\hat{V}|h]$
- ▶ We focus on the more realistic case that $Q_L > 0$

Optimal pricing

- ▶ Losses from issuers per security are $\frac{\hat{\Pi}_C}{Q}$
- ▶ Profits for investors are $E[\hat{V}|h] - S_h$
- ▶ These are identical, hence $E[\hat{V}|h] - S_h = \frac{\hat{\Pi}_C}{Q}$
- ▶ We have $E[E[\hat{V}|h]] = E[\hat{V}] = \frac{1}{2}$
- ▶ This gives taking an expected price of $E[S_h] = \frac{1}{2} - \frac{\hat{\Pi}_C}{Q}$

Minimal offer price

- ▶ We can derive that $\frac{\partial \hat{\Pi}_C}{\partial N} < 0$ and having more investors reduces the losses to issuers
- ▶ Smallest possible N is if all investors having positive signals would buy the entire issue
- ▶ If each investor takes \bar{Q} securities at most, $h\bar{Q} = N\bar{Q} = Q$
- ▶ This gives $\hat{\Pi}_C \geq \frac{Q}{2(N+2)}$
- ▶ Implying $E[S_h] \geq \frac{1}{2} - \frac{1}{2(N+2)} \geq \frac{1}{3}$
- ▶ The price is at least as high or higher than in a bidding process

Impact of competition

- ▶ We see that $\lim_{N \rightarrow \infty} \hat{\Pi}_C = 0$
- ▶ Implying that $E[S_h] \rightarrow \frac{1}{2}$, the efficient price, but obtained here with the certainty of selling the entire issue
- ▶ The expected price is higher than in bidding and can approach the efficient price
- ▶ Book-building obtains the highest proceeds to issuers as investors are induced to reveal their information

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Advantages of book-building

- ▶ Book-building induces investors to reveal their information, as only then can they obtain high allocations and make profits
- ▶ Proceeds to issuers are higher than in a bidding process and can approach the efficient price, but ensuring selling all securities
- ▶ Book building is a standard procedure in the underwriting of securities

Book-building as one element of the underwriting process

- ▶ Book-building can be used with best efforts contracts and firm commitment contracts
- ▶ The price emerging from book-building is used as a basis for this contract
- ▶ Obtaining the bids in book-building relies on contacts the investment bank has with investors



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