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Chapter 7.1.2

Book-building

Outline

- 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 $\left[\underline{V};\overline{V}\right]$, 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 $\hat{V}$: $Prob\left(H|\hat{V}\right) = \hat{V}$
- Each possible number of high signals is equally likely at $Prob\,(h) = \frac{1}{N+1}$

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

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: $V_H = \sum_{h=1}^{N} Prob\,(h-1|H)\; E\left[\hat{V}|h\right] = \frac{2}{3}$
- Expected value with low signal: $V_L = \sum_{h=0}^{N-1} Prob\,(h|L)\; E\left[\hat{V}|h\right] = \frac{1}{3}$
- 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

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: $\Pi_D^{HH} = \sum_{h=0}^{N-1} Prob\left(h|H\right)\left(E\left[\hat{V}|h+1\right] - S_H^h\right)Q_H$

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: $\Pi_D^{HL} = \sum_{h=0}^{N-1} Prob\left(h|H\right)\left(E\left[\hat{V}|h+1\right] - S_L^h\right)Q_L$

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
- $\hat{\Pi}_C = \sum_{h=0}^{N} Prob\,(h) \left(E\left[\hat{V}|h\right] - S_h \right) Q$

Minimizing losses

- These losses can be rewritten as
$$\hat{\Pi}_C = \frac{N}{2}\sum_{h=0}^{N-1}\frac{Prob(h|H)}{N+2}Q_L + \frac{N}{2}\sum_{h=0}^{N-1}\left(Prob\left(h|H\right) + Prob\left(h|L\right)\right)\left(E\left[\hat{V}|h\right] - S_h\right)Q_L$$
- This is minimized if the second term vanishes
- Either set $Q_L = 0$ or $S_h = E\left[\hat{V}|h\right]$ 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 $S_h = E\left[\hat{V}|h\right]$
- 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 $E\left[\hat{V}|h\right] - S_h$
- These are identical, hence $E\left[\hat{V}|h\right] - S_h = \frac{\hat{\Pi}_C}{Q}$
- We have $E\left[E\left[\hat{V}|h\right]\right] = E\left[\hat{V}\right] = \frac{1}{2}$
- This gives taking an expected price of $E\left[S_h\right] = \frac{1}{2} - \frac{\hat{\Pi}_C}{Q}$

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 $\overline{Q}$ securities at most, $h\overline{Q} = N\overline{Q} = Q$
- 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 $\lim_{N\to\infty} \hat{\Pi}_C = 0$
- Implying that $E[S_h] \to \frac{1}{2}$, 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

This presentation is based on
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