Andreas Krause

Chapter 7.1.2

Book-building

Outline

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

Copyright © 2024 by Andreas Krause

- A common way for investment banks to establish the offer price when issuing securities, especially in IPOs, is to solicit indicative bids from selected investors and on the basis of their demand determine the final offer price. This process is called book-building.
- We will analyse the benefits of a book building process and also address the question of why investors would reveal their willingness to buy the securities. It would be more beneficial to hide their demand in the anticipation of a lower offer price and the ability to purchase the security at this lower price.
- Investment banks provide incentives for investors to reveal their true preferences for the security and this allows the book building process to achieve a high offer price
- While these incentives are indirectly paid for by the issuer of the security, as we will see, this nevertheless benefits issuers as the higher issue price more than compensates for these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

- We will first look at the price at which the proceeds to the issuer are maximized, which will serve as a benchmark for our analysis.
- We will then assess a standard bidding process for the securities and compare the proceeds the issuer obtains with that of the benchmark.
- Contrasting the proceeds from book-building with that of the bidding process and the optimal price will then allow us to evaluate the reasons why book-building is widespread.

Copyright © 2024 by Andreas Krause

Book-building process

Copyright © 2024 by Andreas Krause

Book-building process

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- ▶
  - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- ▶
  - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- ▶
  - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- ▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

Book-building process

- Investment banks obtain non-binding bids for a security by selected investors

Copyright © 2024 by Andreas Krause

Book-building process

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

▶
- The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
- While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.

▶
- Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
- A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.

▶
- Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
- Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.

▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

Book-building process

- Investment banks obtain non-binding bids for a security by selected investors, but bids are expected to be honoured

Copyright © 2024 by Andreas Krause

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- ▶
  - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- ▶
  - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- ▶
  - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- ▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Book-building process

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- ▶
  - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- ▶
  - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- ▶
  - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- ▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- ▶
  - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- ▶
  - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- ▶
  - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- ▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- ▶
  - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- ▶
  - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- ▶
  - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- ▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

▶
- The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
- While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.

▶
- Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
- A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.

▶
- Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
- Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.

▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Book-building process

→ We will look in a bit more detail at the book-building process and highlight the incentive problems with investors revealing their true opinion about a security. We will then see how incentives to that effect are generated by investment banks, without them facing any costs.

- ▶
  - The book-building process works such that the investment bank contacts selected potential investors and seeks their opinion. These investors are identified by the investment bank through their network of contacts, which is a key benefit of employing investment banks. Those investors the investment bank contacts will evaluate the security and based on their assessment submit a bid for a certain amount at a given price. Such bids are informal and only indicate an interest, but are not legally binding. Therefore in principle they can be withdrawn at any time.
  - While formally non-binding, investment banks expect investors to honour their bids once the security is formally offered for sale. This way the investment bank obtained a true picture of the demand at the formal offer stage.
- ▶
  - Banks use the indicative bids to assess the overall demand for the security and determine a price range at which they intend to offer the security. This range is then published as an indication to all bidders as the formal bids can be submitted. The actual offer price will normally be set within the published range, although this is not always a legal requirement.
  - A key requirement often is that all securities are sold, hence the price must be set accordingly. This requirement is in particular in the interest of investment banks using firm commitment and thus the investment bank does not have to take on any securities it needs to sell at a later stage, exposing them to the possibility of a loss and they have to hold capital against this risk. Not selling all securities will also be seen as a failed sale, affecting the reputation of the investment bank due their wrong assessment of the demand for the security; in addition, it will also affect negatively the company issuing the security as their reputation in future issues might be affected.
- ▶
  - Investors not interested in the security or only willing to pay a very low price would not hesitate to reveal this information. This information would affect the price negatively, which is positive for the investor if he was willing to purchase the security and irrelevant for him if he would not want to purchase the security. When holding a positive opinion, revealing this information can be detrimental to the investors own profits.
  - Investors holding positive opinions would not want to reveal this fact as this information would increase the offer price and the profits they would make, reduces.
- ▶ As an incentive for those investors will to pay a high price to reveal this information, the investment bank will agree to give them priority in the allocation of securities. In order for the investment bank to have the discretion in allocating securities, the demand for securities at the final offer price has to exceed the number of securities sold. This implies that the issue is underpriced. Assuming that once trading commences, the security is traded at its equilibrium price, where demand and supply meet, the price will increase and anyone purchasing the security at the offer price will make a profit. Hence those investors revealing their opinions will be rewarded with a profit.

→ The book-building process only works if investors reveal their opinions truthfully and the mechanism to achieve this is by rewarding investors through allocating them underpriced shares. Underpricing reduces the revenue available to the issuer, who indirectly pays these incentives, but the investment bank does not contribute to these costs.

Copyright © 2024 by Andreas Krause

Security value and signals

Copyright © 2024 by Andreas Krause

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

Security value and signals

- Each of the N investors receives a high (H) or low (L) signal on the value of the security

Copyright © 2024 by Andreas Krause

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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 $[\underline{V};\overline{V}]$

Copyright © 2024 by Andreas Krause

Security value and signals

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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 $\hat{V} \in [0;1]$

Copyright © 2024 by Andreas Krause

Security value and signals

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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 $\hat{V}$

Copyright © 2024 by Andreas Krause

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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 $\hat{V}$: $Prob\left(H|\hat{V}\right) = \hat{V}$

Copyright © 2024 by Andreas Krause

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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 $Prob\left(h\right) = \frac{1}{N+1}$

Copyright © 2024 by Andreas Krause

- $\rightarrow$ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.
- ▶ We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
- ▶
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
- ▶
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- ▶ We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.
- $\rightarrow$ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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 $Prob\left(h\right) = \frac{1}{N+1}$

Copyright © 2024 by Andreas Krause

Security value and signals

→ First we determine the assumptions about key components of the model, the value of the security, and the opinions about the security, called the signal.

- We assume that investors have information or opinions about the security and this is signalling to them either a high or low value. Hence the information or opinion they hold is discrete.
-
  - While the signal is discrete, the value of the security is continuous and distributed uniformly with an interval. This assumption seems strong, but it is a common assumption if no information on a random variable is available.
  - To simplify the analysis, we transform this variable into one that is distributed between 0 and 1. This is only to allow us to simplify notation by eliminating $\overline{V}$ and $\underline{V}$. A value can then be interpreted as its position between these two values, hence a value of $\frac{1}{2}$ would lie halfway between $\overline{V}$ and $\underline{V}$.
-
  - The higher the real value of security, the more likely the high signal is received by investors; hence the higher the real value of the security, the higher the expected value of the security for the investor. The normalisation allows us to assume that if the security has a specific value $\hat{V}$, that the high signal is received with exactly that probability, $\hat{V}$.
  - This can be more formally be defined as indicated here.
- We further assume the the number of high signals received, h, is uniformely distributed. As there are N investors, there are $N+1$ possible high signals, including that no high signal is received.

→ We assume that the value of securities are uniformely distributed and that the number of highnals are also uniformely distributed. These assumption simplify the analysis, but in principle can be replaced by more realistic assumptions.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

- Using these assumptions, we will now determine the price that maximizes the revenue to the issuer of the security.
- This price will then serve as a benchmark to compare different mechanisms of selling securities.

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

→ We will look at how prices are optimally set using the information available, if the true value of the security is unknown. We will then look at what this implies for the revenue the issuer obtains.

- The issuers seeks to sell a total quantity of Q securities. In order to sell these, it needs at least h^* positive signals (opinions). This is easily justified if we assume that each investor will only purchase the security if its opinion is positive and the amount each investor purchases, requires h^* such investors to sell all the securities.
- The offer price is set efficiently to reflect the available information, which here is the number of high signals. While normally the signals are only observed by the investors themselves, we here assume that a social planner conducts the pricing who has access to this information.
- If not all securities can be sold, we assume that no securities at all are sold. This is an all-or-nothing situation and it would lead to the situation where an issue that is not a success in selling all securities, is withdrawn. The issuer obtains revenue only if enough investors have obtained a positive signal, which happens with probability $Prob\left(h \geq h^*\right)$, otherwise no revenue is obtained as the issue is withdrawn. The issuer then obtains the price set based on the number of positive signals, $E\left[\hat{V}|h^*\right]$, and it sells the quantity Q.
- We can now use our assumptions that the value of the security is uniformly distributed and that the number of positive signals is uniformly distributed to obtain an expression for the revenue of the issuer. The first term follows directly from the uniform distribution of the number of positive signals, the second term can be derived similarly.

→ Having obtained the revenue the revenue of the issuer, we can now set a price such that it maximizes this revenue.

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

- An issuer can sell all Q securities, if at least h^* high signals are received

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

→ We will look at how prices are optimally set using the information available, if the true value of the security is unknown. We will then look at what this implies for the revenue the issuer obtains.

- The issuers seeks to sell a total quantity of Q securities. In order to sell these, it needs at least h^* positive signals (opinions). This is easily justified if we assume that each investor will only purchase the security if its opinion is positive and the amount each investor purchases, requires h^* such investors to sell all the securities.
- The offer price is set efficiently to reflect the available information, which here is the number of high signals. While normally the signals are only observed by the investors themselves, we here assume that a social planner conducts the pricing who has access to this information.
- If not all securities can be sold, we assume that no securities at all are sold. This is an all-or-nothing situation and it would lead to the situation where an issue that is not a success in selling all securities, is withdrawn. The issuer obtains revenue only if enough investors have obtained a positive signal, which happens with probability $Prob\left(h \geq h^*\right)$, otherwise no revenue is obtained as the issue is withdrawn. The issuer then obtains the price set based on the number of positive signals, $E\left[\hat{V}|h^*\right]$, and it sells the quantity Q.
- We can now use our assumptions that the value of the security is uniformly distributed and that the number of positive signals is uniformly distributed to obtain an expression for the revenue of the issuer. The first term follows directly from the uniform distribution of the number of positive signals, the second term can be derived similarly.

→ Having obtained the revenue the revenue of the issuer, we can now set a price such that it maximizes this revenue.

Copyright © 2024 by Andreas Krause

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:
  $S = E\left[\hat{V}|h^*\right]$

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

→ We will look at how prices are optimally set using the information available, if the true value of the security is unknown. We will then look at what this implies for the revenue the issuer obtains.

- The issuers seeks to sell a total quantity of Q securities. In order to sell these, it needs at least h^* positive signals (opinions). This is easily justified if we assume that each investor will only purchase the security if its opinion is positive and the amount each investor purchases, requires h^* such investors to sell all the securities.
- The offer price is set efficiently to reflect the available information, which here is the number of high signals. While normally the signals are only observed by the investors themselves, we here assume that a social planner conducts the pricing who has access to this information.
- If not all securities can be sold, we assume that no securities at all are sold. This is an all-or-nothing situation and it would lead to the situation where an issue that is not a success in selling all securities, is withdrawn. The issuer obtains revenue only if enough investors have obtained a positive signal, which happens with probability $Prob\left(h \geq h^*\right)$, otherwise no revenue is obtained as the issue is withdrawn. The issuer then obtains the price set based on the number of positive signals, $E\left[\hat{V}|h^*\right]$, and it sells the quantity Q.
- We can now use our assumptions that the value of the security is uniformly distributed and that the number of positive signals is uniformly distributed to obtain an expression for the revenue of the issuer. The first term follows directly from the uniform distribution of the number of positive signals, the second term can be derived similarly.

→ Having obtained the revenue the revenue of the issuer, we can now set a price such that it maximizes this revenue.

Copyright © 2024 by Andreas Krause

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: $\Pi_C = Prob\left(h \geq h^*\right) E\left[\hat{V}|h^*\right] Q$

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

→ We will look at how prices are optimally set using the information available, if the true value of the security is unknown. We will then look at what this implies for the revenue the issuer obtains.

- The issuers seeks to sell a total quantity of Q securities. In order to sell these, it needs at least h^* positive signals (opinions). This is easily justified if we assume that each investor will only purchase the security if its opinion is positive and the amount each investor purchases, requires h^* such investors to sell all the securities.
- The offer price is set efficiently to reflect the available information, which here is the number of high signals. While normally the signals are only observed by the investors themselves, we here assume that a social planner conducts the pricing who has access to this information.
- If not all securities can be sold, we assume that no securities at all are sold. This is an all-or-nothing situation and it would lead to the situation where an issue that is not a success in selling all securities, is withdrawn. The issuer obtains revenue only if enough investors have obtained a positive signal, which happens with probability $Prob\left(h \geq h^*\right)$, otherwise no revenue is obtained as the issue is withdrawn. The issuer then obtains the price set based on the number of positive signals, $E\left[\hat{V}|h^*\right]$, and it sells the quantity Q.
- We can now use our assumptions that the value of the security is uniformly distributed and that the number of positive signals is uniformly distributed to obtain an expression for the revenue of the issuer. The first term follows directly from the uniform distribution of the number of positive signals, the second term can be derived similarly.

→ Having obtained the revenue the revenue of the issuer, we can now set a price such that it maximizes this revenue.

Copyright © 2024 by Andreas Krause

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: $\Pi_C = Prob\left(h \geq h^*\right) E\left[\hat{V}|h^*\right] Q$
- Using statistics, we get $\Pi_C = \left(1 - \frac{h^*}{N+1}\right) \frac{h^*+1}{N+2} Q$

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

→ We will look at how prices are optimally set using the information available, if the true value of the security is unknown. We will then look at what this implies for the revenue the issuer obtains.

- The issuers seeks to sell a total quantity of Q securities. In order to sell these, it needs at least h^* positive signals (opinions). This is easily justified if we assume that each investor will only purchase the security if its opinion is positive and the amount each investor purchases, requires h^* such investors to sell all the securities.
- The offer price is set efficiently to reflect the available information, which here is the number of high signals. While normally the signals are only observed by the investors themselves, we here assume that a social planner conducts the pricing who has access to this information.
- If not all securities can be sold, we assume that no securities at all are sold. This is an all-or-nothing situation and it would lead to the situation where an issue that is not a success in selling all securities, is withdrawn. The issuer obtains revenue only if enough investors have obtained a positive signal, which happens with probability $Prob\left(h \geq h^*\right)$, otherwise no revenue is obtained as the issue is withdrawn. The issuer then obtains the price set based on the number of positive signals, $E\left[\hat{V}|h^*\right]$, and it sells the quantity Q.
- We can now use our assumptions that the value of the security is uniformly distributed and that the number of positive signals is uniformly distributed to obtain an expression for the revenue of the issuer. The first term follows directly from the uniform distribution of the number of positive signals, the second term can be derived similarly.

→ Having obtained the revenue the revenue of the issuer, we can now set a price such that it maximizes this revenue.

Copyright © 2024 by Andreas Krause

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: $\Pi_C = Prob\left(h \geq h^*\right) E\left[\hat{V}|h^*\right] Q$
- Using statistics, we get $\Pi_C = \left(1 - \frac{h^*}{N+1}\right) \frac{h^*+1}{N+2} Q$

Copyright © 2024 by Andreas Krause

Price setting and issuer proceeds

→ We will look at how prices are optimally set using the information available, if the true value of the security is unknown. We will then look at what this implies for the revenue the issuer obtains.

- The issuers seeks to sell a total quantity of Q securities. In order to sell these, it needs at least h^* positive signals (opinions). This is easily justified if we assume that each investor will only purchase the security if its opinion is positive and the amount each investor purchases, requires h^* such investors to sell all the securities.
- The offer price is set efficiently to reflect the available information, which here is the number of high signals. While normally the signals are only observed by the investors themselves, we here assume that a social planner conducts the pricing who has access to this information.
- If not all securities can be sold, we assume that no securities at all are sold. This is an all-or-nothing situation and it would lead to the situation where an issue that is not a success in selling all securities, is withdrawn. The issuer obtains revenue only if enough investors have obtained a positive signal, which happens with probability $Prob\left(h \geq h^*\right)$, otherwise no revenue is obtained as the issue is withdrawn. The issuer then obtains the price set based on the number of positive signals, $E\left[\hat{V}|h^*\right]$, and it sells the quantity Q.
- We can now use our assumptions that the value of the security is uniformly distributed and that the number of positive signals is uniformly distributed to obtain an expression for the revenue of the issuer. The first term follows directly from the uniform distribution of the number of positive signals, the second term can be derived similarly.

→ Having obtained the revenue the revenue of the issuer, we can now set a price such that it maximizes this revenue.

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

- Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
-
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
-
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
-
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

- Maximizing proceeds gives the optimal threshold h^* as $h^* = \frac{N}{2}$

Copyright © 2024 by Andreas Krause

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

- Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
-
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
-
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
-
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

- Maximizing proceeds gives the optimal threshold h^* as $h^* = \frac{N}{2}$
- This then gives the offer price as $S = \frac{1}{2}$

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

- Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
-
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
-
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
-
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

- Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
-
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
-
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
-
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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 $\Pi_C = \frac{1}{4}\frac{N+2}{N+1}Q$

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

- Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
-
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
-
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
-
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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 $\Pi_C = \frac{1}{4}\frac{N+2}{N+1}Q \approx \frac{1}{4}Q$

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

▶ Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.

▶
- We can insert this result into the offer price and obtain this value.
- The offer price is exactly the expected value of the security, which was uniformly distributed.

▶
- If we insert all of these variables into the issuer proceedings, we can get this amount.
- If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.

▶
- As securities are priced at the expected value, the offer price can be interpreted as being fair.
- There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
- If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

▶ Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.

▶
- We can insert this result into the offer price and obtain this value.
- The offer price is exactly the expected value of the security, which was uniformly distributed.

▶
- If we insert all of these variables into the issuer proceedings, we can get this amount.
- If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.

▶
- As securities are priced at the expected value, the offer price can be interpreted as being fair.
- There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
- If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

- → An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.
- ▶ Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
- ▶
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
- ▶
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
- ▶
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.
- → We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

- Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.
-
  - We can insert this result into the offer price and obtain this value.
  - The offer price is exactly the expected value of the security, which was uniformly distributed.
-
  - If we insert all of these variables into the issuer proceedings, we can get this amount.
  - If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.
-
  - As securities are priced at the expected value, the offer price can be interpreted as being fair.
  - There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
  - If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Optimal price and proceeds

→ An underwriting process that works well for the issuer is one which maximizes the revenue that is raised. We will therefore nnow conduct this maximization and look at the resulting offer price and total revenue to the issuer.

▶ Rather than maximizing for the offer price directly, we see that the revenue is affected by the number of high signals required to sell the entire issue. We can maximize for this value by setting the first derivative zero and solving for this value gives us that half the investors should receive a positive value.

▶
- We can insert this result into the offer price and obtain this value.
- The offer price is exactly the expected value of the security, which was uniformly distributed.

▶
- If we insert all of these variables into the issuer proceedings, we can get this amount.
- If the number of investors is high, a larger N, then $\frac{N+2}{N+1}$ is approximately 1 and the expression can be simplified.

▶
- As securities are priced at the expected value, the offer price can be interpreted as being fair.
- There is however the chance the issue is not fully sold and that probability is $\frac{1}{2}$ as we need half of all investors to obtain a positive signal. As the revenue is $\frac{1}{4}Q$, and the offer price $\frac{1}{2}$, the revenue if the securities are sold is $\frac{1}{2}Q$, giving the probability of the securities being sold $\frac{1}{2}$.
- If the offer is abandoned or withdrawn, then no revenue is obtained.

→ We have established that the offer price maximizing the revenue of issuers is the expected value of the securities and the total expected revenue is $\frac{1}{4}Q$. We can use this result now to compare mechanisms to sell securities and determine which gets closest to this optimum.

Copyright © 2024 by Andreas Krause

Copyright © 2024 by Andreas Krause

- In a bidding process, no optimisation of revenue is conducted by a social planner, but instead all investors submit their bids for the security and the price is then determined such that all securities are sold.
- We will now investigate such a process and compare the results to the efficient pricing.

Copyright © 2024 by Andreas Krause

The importance of signals

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

-
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
-
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
-
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
-
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

The importance of signals

- Investors submit bids based on their own signal

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

The importance of signals

- Investors submit bids based on their own signal, but they also infer what information other investors have

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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 $Prob\,(h|L)$

Copyright © 2024 by Andreas Krause

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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: $Prob\left(h|H\right)$ and $Prob\left(h|L\right)$
- Expected value with high signal: $V_H = \sum_{h=1}^{N} Prob\left(h-1|H\right) E\left[\hat{V}|h\right]$

Copyright © 2024 by Andreas Krause

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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: $V_H = \sum_{h=1}^{N} Prob\,(h-1|H)\,E\left[\hat{V}|h\right] = \frac{2}{3}$

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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: $V_L = \sum_{h=0}^{N-1} Prob\,(h|L)\, E\left[\hat{V}|h\right]$

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N - 1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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: $V_L = \sum_{h=0}^{N-1} Prob\,(h|L)\, E\left[\hat{V}|h\right] = \frac{1}{3}$

Copyright © 2024 by Andreas Krause

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- ▶
  - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- ▶
  - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- ▶
  - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- ▶
  - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N - 1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- ▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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: $Prob\left(h|H\right)$ and $Prob\left(h|L\right)$
- Expected value with high signal: $V_H = \sum_{h=1}^{N} Prob\left(h-1|H\right) E\left[\hat{V}|h\right] = \frac{2}{3}$
- Expected value with low signal: $V_L = \sum_{h=0}^{N-1} Prob\left(h|L\right) E\left[\hat{V}|h\right] = \frac{1}{3}$
- All investors assess the value of the issue to be either $\frac{1}{3}$ or $\frac{2}{3}$

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

▶
- The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
- They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.

▶
- Investors knowing their own signal, can seek to infer the number of high signals, h.
- This number of high signals will include their own high signal, if relevant.
- This assessment would be conditional on their own signal.
- *Formula*

▶
- The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
- We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.

▶
- The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
- We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.

▶ We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

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: $Prob\left(h|H\right)$ and $Prob\left(h|L\right)$
- Expected value with high signal: $V_H = \sum_{h=1}^{N} Prob\left(h-1|H\right) E\left[\hat{V}|h\right] = \frac{2}{3}$
- Expected value with low signal: $V_L = \sum_{h=0}^{N-1} Prob\left(h|L\right) E\left[\hat{V}|h\right] = \frac{1}{3}$
- All investors assess the value of the issue to be either $\frac{1}{3}$ or $\frac{2}{3}$

Copyright © 2024 by Andreas Krause

The importance of signals

→ We first consider a traditional bidding process, where investors, based on their own information, decide whether to purchase the security. Based on the decisions of all investors, we can then assess the implications for the offer price and the revenue to the issuer.

- - The information investors hold is the signal they receive about the value of the security and they will use this signal to inform their submission of a bid.
  - They will also seek to infer what information the other investors have and take that into account when making their bid as it will affect the price they will obtain.
- - Investors knowing their own signal, can seek to infer the number of high signals, h.
  - This number of high signals will include their own high signal, if relevant.
  - This assessment would be conditional on their own signal.
  - *Formula*
- - The expected value of the security, given the high signal can now be calculated. We need to determine the expected value of the security for each possible number positive signals. The probability of observing this number of positive signals, given your own signal is positive can also be determined, where we need to take into account that the investor knows that at least one signal was positive, his own. We then need to consider all these cases and obtain the expected offer price.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{2}{3}$.
- - The same can now be repeated for the case that the investor receives a negative signal. In this case the most positive signals that can be observed is $N-1$ as the signal of the investor itself is already negative.
  - We can evaluate these probabilities and using statistics obtain that this expected offer price for an investor receiving a positive signal is $\frac{1}{3}$.
- We now know that investors assess the value of the security one of these two value, depending on what signal they receive.

→ Using this information, we can now determine the optimal offer price and the resulting revenue for the issuer.

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

- Setting $S \leq \frac{1}{3}$ ensures all securities are sold as every investor makes profit

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

▶
- As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
- A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
- For this reason no price below $\frac{1}{3}$ will be chosen.

▶
- As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
- This is because investors would make a loss from purchasing the security at a price above its valuation.

▶
- The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
- How many such high signals are received across all investors is uncertain.

▶
- To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
- The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.

▶
- The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
- As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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 $\Pi_C = \frac{1}{3}Q$

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring the issue is sold

→ A concern for the issuer is to sell the issue and that may well take precedence over obtaining a high price for the issue. We will now take the expected value of the securities as determined by investors with different signals and compare the impact different offer prices have on the revenue to issuers.

- ▶
  - As the value is either $\frac{1}{3}$ or $\frac{2}{3}$, setting an offer price at or below $\frac{1}{3}$ would ensure ever investor purchases the security and the issue is fully sold.
  - A price below $\frac{1}{3}$ would not increase the number of securities sold as already all securities will be sold at $\frac{1}{3}$, but it will only reduce the revenue the issuer obtains.
  - For this reason no price below $\frac{1}{3}$ will be chosen.
- ▶
  - As the value is at most $\frac{2}{3}$, setting an offer price above this value will result in no securities at all being sold.
  - This is because investors would make a loss from purchasing the security at a price above its valuation.
- ▶
  - The number of securities to be sold at $\frac{2}{3}$ is uncertain as the issue would only be sold to those investors receiving a high signal.
  - How many such high signals are received across all investors is uncertain.
- ▶
  - To avoid this uncertainty, the issue price might be set at $\frac{1}{3}$ and as all investors value the security at least at that price, the entire issue would be sold with certainty.
  - The revenue in this case is certain as all securities are sold at this price and we obtain the revenue accordingly.
- ▶
  - The efficient price was $\frac{1}{2}$ and therefore the price obtained in a bidding process is lower.
  - As the issue is fully sold at this price, the expected revenue is higher than in efficient pricing, where the issue was fully sold only in half of the cases.

→ Using a bidding process generates higher revenue for issuers than efficient pricing despite a lower offer price as the issue is sold with certainty. Being able to sell the issue is the main advantage of a bidding process. Unlike in efficient pricing, there is no reliance on expected signals but all bids are based on actually obtained signals, ensuring all securities can be sold.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

- Having established that bidding process generates a higher revenue for the issuer, despite attracting a lower price, we can now introduce book building and compare the revenue it generates to issuers.

Copyright © 2024 by Andreas Krause

Bidding process

Copyright © 2024 by Andreas Krause

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

- ▶
  - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- ▶ In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- ▶ The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- ▶ The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

Bidding process

- Investors submit bids for securities

Copyright © 2024 by Andreas Krause

Bidding process

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

- - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

Bidding process

- Investors submit bids for securities and once all bids are submitted, a price is determined and securities allocated

Copyright © 2024 by Andreas Krause

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

-
  - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Bidding process

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

-
  - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Bidding process

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

- - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

-
  - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Bidding process

→ The bidding process in book-building is slightly different to that in a standard bidding process. To make the process tractable within our modelling framework, we need to make some adjustments on the details of the bidding process, but will retain the key properties of the procedure.

- - As with the standard bidding process, we assume that investors submit bids for the securities based on their own signal.
  - Based on all the bids received, a price will be determined and the securities allocated to investors.
- In deviation from the standard bidding process, we assume that investors do not directly submit a bid to purchase the security, but instead they report whether they have obtained a high or low signal. This reflects more the book-building process where investors report what price they are willing to buy the security for, which would reveal the information they have obtained. This assumption of submitting the signal replicates this aspect of the book-building process.
- The allocation of securities will depend on whether a high or low signal was received. Priority would be given to those reporting a high signal.
- The aim of this allocation rule is to ensure that signals are reported truthfully. Those with high signals should find it more profitable to report a high signal, while those with low signals should report those. Therefore a higher allocation of those reporting high signals should not provide an incentive for low signals to be discarded.

→ While this process seems slightly different from the two-stage process of indicative bids to determine a price range and then obtaining firm bids, it takes into account that indicative bids are seen expected to be honoured and hence we consider only one round of bidding as the second round of actual bids would be a replication. The fact that bids are seen as information also reflects the property in book-building of indicative bids to be a true reflection of the information they have obtained. We have therefore capture the essence of the book-building process.

Copyright © 2024 by Andreas Krause

Investors with high signal reported truthfully

Copyright © 2024 by Andreas Krause

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
    - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
    - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

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 $E\left[\hat{V}|h+1\right]$

- Profits are: $\Pi_D^{HH} = \qquad \left(E\left[\hat{V}|h+1\right] \qquad \right)$

Copyright © 2024 by Andreas Krause

Investors with high signal reported truthfully

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

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
- Profits are: $\Pi_D^{HH} = \qquad \left(E\left[\hat{V}|h+1\right] - S_H^h\right)$

Copyright © 2024 by Andreas Krause

Investors with high signal reported truthfully

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
    - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
    - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

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

- Profits are: $\Pi_D^{HH} = \left(E\left[\hat{V}|h+1\right] - S_H^h\right) Q_H$

Copyright © 2024 by Andreas Krause

Investors with high signal reported truthfully

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
    - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
    - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

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

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

Copyright © 2024 by Andreas Krause

Investors with high signal reported truthfully

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
    - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
    - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Investors with high signal reported truthfully

→ We first have to ensure that investors having obtained a high signal report this as a high signal, thus do not pretend to have obtained a low signal to reduce the offer price. To this effect we first assess what profits an investor makes who has received a high signal and reports this.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
    - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
    - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting this signal truthfully.

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- The value of the security remains unaffected by the reporting of the signal as the investor holds the information.

- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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 $E\left[\hat{V}|h+1\right]$

- Profits are: $\Pi_D^{HL} = \qquad \left(E\left[\hat{V}|h+1\right] \qquad \right)$

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

-
  - If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
  - The value of the security remains unaffected by the reporting of the signal as the investor holds the information.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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
- Profits are: $\Pi_D^{HL} = \qquad \left(E\left[\hat{V}|h+1\right] \qquad \right)$

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- The value of the security remains unaffected by the reporting of the signal as the investor holds the information.

- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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
- Profits are: $\Pi_D^{HL} = \left(E\left[\hat{V}|h+1\right] - S_L^h\right)$

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- The value of the security remains unaffected by the reporting of the signal as the investor holds the information.

- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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
- Profits are: $\Pi_D^{HL} = \left(E\left[\hat{V}|h+1\right] - S_L^h\right) Q_L$

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

- → We now consider the case where an investor having received a high signal, reports that it has received a low signal.
-
    - If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
    - The value of the security remains unaffected by the reporting of the signal as the investor holds the information.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
-
    - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
    - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.
- → This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- The value of the security remains unaffected by the reporting of the signal as the investor holds the information.

- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Investor with high signal not reported truthfully

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

- - If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
  - The value of the security remains unaffected by the reporting of the signal as the investor holds the information.
- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
- - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

- → We now consider the case where an investor having received a high signal, reports that it has received a low signal.
- ▶
  - If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
  - The value of the security remains unaffected by the reporting of the signal as the investor holds the information.
- ▶ We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- ▶ The allocation of the security might also depend on the signal that has been reported.
- ▶
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- ▶ The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.
- → This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We now consider the case where an investor having received a high signal, reports that it has received a low signal.

- If there are already h high signals reported, the signal of the investor will make it $h+1$ high signals and the value of the security will be determined accordingly.
- The value of the security remains unaffected by the reporting of the signal as the investor holds the information.

- We will assume that the offer price will not necessarily be the expected value of the security, but it might be some other offer price.
- The allocation of the security might also depend on the signal that has been reported.
  - As the investor does not know how many high signals have been submitted, it has to consider the probability of other investors having this many high signals.
  - We need to consider all possible number of high signals, where at most $N-1$ other investors can have a high signal.
- The profits are the difference between the value of the security and its offer price for each security allocated, where the expected value is then obtained by considering the probability of the number of other investors having high signals.

→ This has given us the profits of an investor with a high signal reporting a low signal. We can now compare the profits of revealing the high signal truthfully and reporting a low signal instead.

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

-
  - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
-
  - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

- An investor receiving a low signal, would not report a high signal

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

- - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
- - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

-
  - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
-
  - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

- - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
- - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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 $\Pi_D^{HH} \geq \Pi_D^{HL}$

Copyright © 2024 by Andreas Krause

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

-
  - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
-
  - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

-
  - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
-
  - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

-
  - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
-
  - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Ensuring signals are revealed truthfully

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

- - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
- - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We need to ensure that investors reveal the signal they have actually received and not one that reduces the offer price and thus increases their profits.

-
  - We can now show that an investor with a low signal will never pretend to have obtained a high signal as this is not profitable for him.
  - Reporting a high signal will increase the expected value of the security and therefore the offer price.
  - A higher price will reduce and profits of the investor, making this strategy not desirable. While a higher allocation could in principle compensate for these reduced profits, if all investors would be reporting high signals, the impact of the price would be such that investors would make smaller profits.
- If we focus on investors with high signals, they report them truthfully if it is more profitable to do so.
-
  - If we were to lower the price if the high signal is reported, the profits of the investor would increase, making this strategy viable, but the proceeds to the issuer would reduce due to the lower offer price, which is not optimal.
  - If we fix the price at a level that maximizes proceeds that would be beneficial to the issuer.
- The alternative we have is to lower the allocation of securities to those that report a low signal. As long as the entire issue is sold, the revenue to the issuer is not affected and the investor gets a higher profit for reporting a high signal due to having been allocated more securities at the same price.

→ We have now established that investors reporting a high signal will obtain a larger allocation of securities to incentivise them to report their signal truthfully. We can now continue to see how this can be implemented such that the proceeds to the issuer are maximized.

Copyright © 2024 by Andreas Krause

Issuer losses

Copyright © 2024 by Andreas Krause

→ If investors make profits, the issuer will make a loss as the issue is not sold at the highest possible price.

-
  - We now have to consider the allocated securities to those that have high signals that have reported them truthfully
  - as well as those with low signals, also reported truthfully.
- The total number of securities need to be sold, hence the allocation to the h investors with high signals and the allocation to the remaining $N-h$ investors with low signals need to equal the number of securities issued.
- If investors make a profit by obtaining the security below its true value, the issuer will make that amount as a loss as it sells off its securities below value. The issuer faces these losses on the entire issue of securities.
- *Formula*

→ Now that we have the losses of the issuer, we can determine the optimal pricing strategy and allocation policy by minimizing the losses of the issuer.

Copyright © 2024 by Andreas Krause

Issuer losses

- Securities issued are held by those with high signals getting Q_H each

Copyright © 2024 by Andreas Krause

Issuer losses

- → If investors make profits, the issuer will make a loss as the issue is not sold at the highest possible price.
-
    - We now have to consider the allocated securities to those that have high signals that have reported them truthfully
    - as well as those with low signals, also reported truthfully.
- The total number of securities need to be sold, hence the allocation to the h investors with high signals and the allocation to the remaining $N - h$ investors with low signals need to equal the number of securities issued.
- If investors make a profit by obtaining the security below its true value, the issuer will make that amount as a loss as it sells off its securities below value. The issuer faces these losses on the entire issue of securities.
- *Formula*
- → Now that we have the losses of the issuer, we can determine the optimal pricing strategy and allocation policy by minimizing the losses of the issuer.

Copyright © 2024 by Andreas Krause

Issuer losses

- Securities issued are held by those with high signals getting Q_H each and low signals getting Q_L each

Copyright © 2024 by Andreas Krause

Issuer losses

→ If investors make profits, the issuer will make a loss as the issue is not sold at the highest possible price.

-
  - We now have to consider the allocated securities to those that have high signals that have reported them truthfully
  - as well as those with low signals, also reported truthfully.
- The total number of securities need to be sold, hence the allocation to the h investors with high signals and the allocation to the remaining $N-h$ investors with low signals need to equal the number of securities issued.
- If investors make a profit by obtaining the security below its true value, the issuer will make that amount as a loss as it sells off its securities below value. The issuer faces these losses on the entire issue of securities.
- *Formula*

→ Now that we have the losses of the issuer, we can determine the optimal pricing strategy and allocation policy by minimizing the losses of the issuer.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Issuer losses

- → If investors make profits, the issuer will make a loss as the issue is not sold at the highest possible price.
- ▶
  - We now have to consider the allocated securities to those that have high signals that have reported them truthfully
  - as well as those with low signals, also reported truthfully.
- ▶ The total number of securities need to be sold, hence the allocation to the h investors with high signals and the allocation to the remaining $N-h$ investors with low signals need to equal the number of securities issued.
- ▶ If investors make a profit by obtaining the security below its true value, the issuer will make that amount as a loss as it sells off its securities below value. The issuer faces these losses on the entire issue of securities.
- ▶ *Formula*
- → Now that we have the losses of the issuer, we can determine the optimal pricing strategy and allocation policy by minimizing the losses of the issuer.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Issuer losses

→ If investors make profits, the issuer will make a loss as the issue is not sold at the highest possible price.

-
  - We now have to consider the allocated securities to those that have high signals that have reported them truthfully
  - as well as those with low signals, also reported truthfully.
- The total number of securities need to be sold, hence the allocation to the h investors with high signals and the allocation to the remaining $N - h$ investors with low signals need to equal the number of securities issued.
- If investors make a profit by obtaining the security below its true value, the issuer will make that amount as a loss as it sells off its securities below value. The issuer faces these losses on the entire issue of securities.
- *Formula*

→ Now that we have the losses of the issuer, we can determine the optimal pricing strategy and allocation policy by minimizing the losses of the issuer.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Issuer losses

→ If investors make profits, the issuer will make a loss as the issue is not sold at the highest possible price.

- ▶
  - We now have to consider the allocated securities to those that have high signals that have reported them truthfully
  - as well as those with low signals, also reported truthfully.
- ▶ The total number of securities need to be sold, hence the allocation to the h investors with high signals and the allocation to the remaining $N-h$ investors with low signals need to equal the number of securities issued.
- ▶ If investors make a profit by obtaining the security below its true value, the issuer will make that amount as a loss as it sells off its securities below value. The issuer faces these losses on the entire issue of securities.
- ▶ *Formula*

→ Now that we have the losses of the issuer, we can determine the optimal pricing strategy and allocation policy by minimizing the losses of the issuer.

Copyright © 2024 by Andreas Krause

Minimizing losses

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h) Q_L$ and insert for $Prob(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

- These losses can be rewritten as

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

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h) Q_L$ and insert for $Prob\,(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

- These losses can be rewritten as
$$\hat{\Pi}_C = \frac{N}{2}\sum_{h=0}^{N-1}\frac{Prob(h|H)}{N+2}Q$$
$$+\frac{N}{2}\sum_{h=0}^{N-1}\left(Prob\left(h|H\right)+Prob\left(h|L\right)\right)\left(E\left[\hat{V}|h\right]-S_h\right)Q_L$$
- This is minimized if the second term vanishes

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h) Q_L$ and insert for $Prob(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

- These losses can be rewritten as
$$\hat{\Pi}_C = \frac{N}{2}\sum_{h=0}^{N-1}\frac{Prob(h|H)}{N+2}Q + \frac{N}{2}\sum_{h=0}^{N-1}\left(Prob\left(h|H\right)+Prob\left(h|L\right)\right)\left(E\left[\hat{V}|h\right]-S_h\right)Q_L$$
- This is minimized if the second term vanishes
- Either set $Q_L = 0$

Copyright © 2024 by Andreas Krause

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h)\,Q_L$ and insert for $Prob\,(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

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

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h) Q_L$ and insert for $Prob(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

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

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N-h)Q_L$ and insert for $Prob(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

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

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h)\,Q_L$ and insert for $Prob\,(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

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

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h)\,Q_L$ and insert for $Prob\,(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
    - To eliminate the second term, we can allocate no shares to investors reporting low signals
    - or set the price efficiently at its expected value.
    - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
    - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
    - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

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

Copyright © 2024 by Andreas Krause

Minimizing losses

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N - h) Q_L$ and insert for $Prob\,(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Minimizing losses

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

Copyright © 2024 by Andreas Krause

→ We now can minimize losses to the issuer by selecting the optimal price and allocation mechanism.

- We can take the losses of the issuer and insert for the total issue size $Q = hQ_H + (N-h)\,Q_L$ and insert for $Prob\,(h)$, then we re-arrange the terms
- For choosing the optimal price, the first term is given and the second term needs to be minimized, while not imposing a loss on investors.
-
  - To eliminate the second term, we can allocate no shares to investors reporting low signals
  - or set the price efficiently at its expected value.
  - We cannot set the price above the expected value and generate profits for issuers as then investors would make a loss and not participate.
-
  - If we do not allocate shares to investors reporting low signals, then the entire expression would be zero, including the first term, but then the demand by investors with high signals must buy up the entire issue.
  - If this is not possible, we need to allocate securities to investors reporting low signals and set the price efficiently at its expected value to eliminate the second term. The allocation to investors reporting low signals will be as small as feasible to minimize the first term.
- That the entire issue can be purchased by those obtaining a high signal is unlikely and we therefore assume that some allocation to investors with low signals is required.

→ We have established that the allocation to investors reporting low signals will be the minimum that is possible to sell the entire issue. The offer price would be the expected value of the security.

Copyright © 2024 by Andreas Krause

Optimal pricing

Copyright © 2024 by Andreas Krause

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

Optimal pricing

- Losses from issuers per security are $\frac{\hat{\Pi}_C}{Q}$

Copyright © 2024 by Andreas Krause

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

Optimal pricing

- Losses from issuers per security are $\frac{\hat{\Pi}_C}{Q}$
- Profits for investors are $E\left[\hat{V}|h\right] - S_h$

Copyright © 2024 by Andreas Krause

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

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 $E\left[\hat{V}|h\right] - S_h = \frac{\hat{\Pi}_C}{Q}$

Copyright © 2024 by Andreas Krause

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

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 $E\left[E\left[\hat{V}|h\right]\right] = E\left[\hat{V}\right] = \frac{1}{2}$

Copyright © 2024 by Andreas Krause

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

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 $E\left[S_h\right] = \frac{1}{2} - \frac{\hat{\Pi}_C}{Q}$

Copyright © 2024 by Andreas Krause

Optimal pricing

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

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 $E\left[S_h\right] = \frac{1}{2} - \frac{\hat{\Pi}_C}{Q}$

Copyright © 2024 by Andreas Krause

Optimal pricing

→ Even though we have determined the optimal offer price as the expected value of the security, this value was conditional on the number of high signals received. This information is available to the investment bank as part of the book-building process as investors reveal their information, but of course it is not available ex-ante before the book-building commences. We will now look at the expected prices and proceeds of issuers when deciding to use book-building, but before having received the information from investors.

- We have the losses to issuers determined before and we can now determine these for each security issued for convenience.
- The profits, per security of investors is the difference between the value of the security and its offer price.
- These two values have to be equal as the profits of the investor is the loss of the issuer.
- We use the law of iterated expectations to eliminate the conditional expectations and then use our assumption of the uniform distribution of the value of the security.
- If we take expectations solve this for the expected offer price, we see that the offer price is the expected security value of $\frac{1}{2}$ less the profits of the investors.

→ Having determined the expected offer price, we can now investigate some properties of this offer price.

Copyright © 2024 by Andreas Krause

Minimal offer price

Copyright © 2024 by Andreas Krause

Minimal offer price

→ We can now determine the price that will be set such that all securities are sold.

-
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
-
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.

→ We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

Minimal offer price

- We can derive that $\frac{\partial \hat{\Pi}_C}{\partial N} < 0$

Copyright © 2024 by Andreas Krause

Minimal offer price

- → We can now determine the price that will be set such that all securities are sold.
-
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
-
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.
- → We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

Minimal offer price

- We can derive that $\frac{\partial \hat{\Pi}_C}{\partial N} < 0$ and having more investors reduces the losses to issuers

Copyright © 2024 by Andreas Krause

→ We can now determine the price that will be set such that all securities are sold.

-
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
-
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.

→ We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We can now determine the price that will be set such that all securities are sold.

-
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
-
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.

→ We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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, $h\overline{Q} = N\overline{Q} = Q$

Copyright © 2024 by Andreas Krause

→ We can now determine the price that will be set such that all securities are sold.

-
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
-
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.

→ We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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 $\hat{\Pi}_C \geq \frac{Q}{2(N+2)}$

Copyright © 2024 by Andreas Krause

Minimal offer price

- → We can now determine the price that will be set such that all securities are sold.
- ▶
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- ▶ The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- ▶ This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- ▶ If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
- ▶
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- ▶ As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.
- → We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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 $E\left[S_h\right] \geq \frac{1}{2} - \frac{1}{2(N+2)}$

Copyright © 2024 by Andreas Krause

Minimal offer price

- → We can now determine the price that will be set such that all securities are sold.
- ▶
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- ▶ The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- ▶ This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- ▶ If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
- ▶
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- ▶ As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.
- → We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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 $E\left[S_h\right] \geq \frac{1}{2} - \frac{1}{2(N+2)} \geq \frac{1}{3}$

Copyright © 2024 by Andreas Krause

- → We can now determine the price that will be set such that all securities are sold.
- ▶
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
- ▶
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.
- → We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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 $E\left[S_h\right] \geq \frac{1}{2} - \frac{1}{2(N+2)} \geq \frac{1}{3}$
- The price is at least as high or higher than in a bidding process

Copyright © 2024 by Andreas Krause

Minimal offer price

→ We can now determine the price that will be set such that all securities are sold.

- - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
- - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.

→ We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

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 $E\left[S_h\right] \geq \frac{1}{2} - \frac{1}{2(N+2)} \geq \frac{1}{3}$
- The price is at least as high or higher than in a bidding process

Copyright © 2024 by Andreas Krause

Minimal offer price

→ We can now determine the price that will be set such that all securities are sold.

-
  - We can take the first derivative of the losses of issuers and can show that this is negative.
  - The losses of the issuer are decreasing the more investors are available. This Is due to the an increasing amount of securities that can be allocated to investors reporting high signals; a higher number of investors will necessarily increase the number of high signals and therefore reduce the need to allocate securities to investors with low signals.
- The smallest number of investors we could afford to have is if they all had high signals and that would buy up the entire securities
- This requires each of these investors to take a fixed amount of security such that the issue is completely sold.
- If we insert this as the minimum number of investors, we can show that the profits are at least as high as given in the *formula*.
-
  - If we insert this minimal profits into the equation for the expected offer price, we see that the expected offer price will be at least the expression given here.
  - As the smallest possible value for the number of investors is one, the expected offer price is at least $\frac{1}{3}$.
- As the offer price in the bidding price was $\frac{1}{3}$, the offer price in book building is higher than in bidding.

→ We have now established that the offer price in book-building is at least as high if not higher than in the bidding process. As in both cases the issue is guaranteed to sell fully, the proceeds for issuers are higher in book-building than in a standard bidding process.

Copyright © 2024 by Andreas Krause

Impact of competition

Copyright © 2024 by Andreas Krause

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

Impact of competition

- We see that $\lim_{N \to \infty} \hat{\Pi}_C = 0$

Copyright © 2024 by Andreas Krause

Impact of competition

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

Impact of competition

- We see that $\lim_{N \to \infty} \hat{\Pi}_C = 0$
- Implying that $E\left[S_h\right] \to \frac{1}{2}$

Copyright © 2024 by Andreas Krause

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

Impact of competition

- We see that $\lim_{N\rightarrow\infty} \hat{\Pi}_C = 0$
- Implying that $E\left[S_h\right] \rightarrow \frac{1}{2}$, the efficient price

Copyright © 2024 by Andreas Krause

Impact of competition

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

Impact of competition

- We see that $\lim_{N\rightarrow\infty} \hat{\Pi}_C = 0$
- Implying that $E\left[S_h\right] \rightarrow \frac{1}{2}$, the efficient price, but obtained here with the certainty of selling the entire issue

Copyright © 2024 by Andreas Krause

Impact of competition

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Impact of competition

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

Impact of competition

- We see that $\lim_{N\to\infty} \hat{\Pi}_C = 0$
- Implying that $E\left[S_h\right] \to \frac{1}{2}$, 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

Copyright © 2024 by Andreas Krause

Impact of competition

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
- - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
- - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
- - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

Impact of competition

- We see that $\lim_{N\rightarrow\infty}\hat{\Pi}_C = 0$
- Implying that $E\left[S_h\right]\rightarrow\frac{1}{2}$, 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

Copyright © 2024 by Andreas Krause

Impact of competition

- → So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.
- ▶ Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
- ▶
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
- ▶
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
- ▶
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.
- → We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Impact of competition

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ So far we looked at the minimum number of investors needed to sell the issue, but we can now let that number increase and see what impact this has on the offer price. The number of investors required might be increasing due to the issue size being larger or because investors are willing to purchase only smaller amounts.

- Looking at the minimum losses issuers make, we see that as the number of investors required to sell the issue, their losses approach zero; this is because more investors increases competition for the issue.
-
  - The minimum expected offer price then approaches $\frac{1}{2}$ as inserting the zero losses easily show.
  - This means the offer price approaches the efficient price that was set as the optimal price maximizing the revenue of the issuer.
  - The efficient offer price was realised at the risk of not selling the entire issue, in contrast to this, with book-building the issue is guaranteed to be sold fully.
-
  - We have that the expected offer price in book-building is higher than in a bidding process, making book-building more attractive.
  - The offer price can even go as high or higher than the efficient price, all the while guaranteeing to sell the issue fully.
-
  - As we had seen that bidding generated higher proceeds for the issuer than efficient pricing due to guaranteeing to sell the issue fully, and book-building on average generates a higher offer than bidding, while also guaranteeing to sell all shares, book-building gives the highest expected proceeds of the three methods discussed. However, there is the risk that the offer price can be lower as this will depend on the signals the investors receive.
  - The reason for the , on average, higher offer price in book-building is the revelation of the signal investors obtain that allows a more accurate determination of the offer price. In the bidding process, the behaviour of investors is strategic in that they seek not to reveal their information and therefore submit more cautious bids as not to affect the offer price too much with their bid. This reduces the demand for the security and depresses the price.

→ We have thus seen that book-building generates ex-ante the highest revenue for issuers, which might explain its dominance in underwriting, especially in IPOs where the information provided by investors is particularly important given the valuation uncertainty.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Advantages of book-building

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

-
  - Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
-
  - The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

Advantages of book-building

- Book-building induces investors to reveal their information

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

- - Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
- - The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

Advantages of book-building

- Book-building induces investors to reveal their information, as only then can they obtain high allocations

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

- • Book-building is a process which induces investors to truthfully tell the information they hold about a security
  • This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  • If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
- • The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  • The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  • Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

Advantages of book-building

- Book-building induces investors to reveal their information, as only then can they obtain high allocations and make profits

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

- - Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
- - The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

-
  - Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
-
  - The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

-
  - Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
-
  - The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

-
  - Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
-
  - The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

- Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
- The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Advantages of book-building

→ We can now summarize the main advantages of book-building over other methods of determining the offer price.

- Book-building is a process which induces investors to truthfully tell the information they hold about a security
  - This is achieved by reducing the allocation of securities for those investors receiving high signals, inducing them to truthfully reveal what they have obtained, rather than seeking to hide their information and reduce the offer price.
  - If they get a larger allocation of the security, investors can investors make higher profits as the issue will be underpriced. This underpricing give them an incentive to seek a high allocation, which is only possible if they reveal their high signal.
- The result of this revelation of information by investors is that due to the higher price and the certainty of selling the entire issue, the revenue for issuers is higher than in other mechanisms.
  - The price can go as high as the efficient price, which is the expected value of the security if the issue is large and many investors are required.
  - Regardless if the signals obtained, book-building ensures that issues are always fully sold, making sure the issue is seen as a success by the market and the investment bank does not make a loss in a firm commitment contract.
- It is for these benefits that book-building is the most commonly used mechanism in underwriting securities, it benefits the issuers most by securing the highest revenue, and as investment banks are paid a fraction of this revenue also maximises the income of investment banks.

→ Book building maximizes the revenue of issuers and the income of investment banks, therefore there is no conflict of interest in using this mechanism between investment banks and their clients.

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

- → Book-building does not characterise the entire underwriting process, but it is only one element, although an important element.
- In principle book-building can be used with best-efforts and firm commitment contract, but given that the issue is guaranteed to sell fully, there is no practical difference between the two contract forms. The firm commitment contract is the most common form.
- The price that emerges from the indicative bids of the book-building process is what is used as the basis of the firm commitment contract, thus the offer price the investment bank guarantees is usually only set at a late stage to virtually no risk for the investment bank.
- A key element for investment banks is to contact the right investors who hold information on the security issued and who are interested in the security. This is where the value of investment banks lies, in their ability to reach investors and get them interested in security issues. The network that investment banks develop makes sure the issue attracts sufficient interest for a high price to be achieved.
- → Book-building eliminates the risk to investment banks, but it also exposes them to reputational risk if they seek to sell to their network of investors securities that eventually turn out to be less valuable than initially thoughy.

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

- Book-building can be used with best efforts contracts and firm commitment contracts

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

- → Book-building does not characterise the entire underwriting process, but it is only one element, although an important element.
- In principle book-building can be used with best-efforts and firm commitment contract, but given that the issue is guaranteed to sell fully, there is no practical difference between the two contract forms. The firm commitment contract is the most common form.
- The price that emerges from the indicative bids of the book-building process is what is used as the basis of the firm commitment contract, thus the offer price the investment bank guarantees is usually only set at a late stage to virtually no risk for the investment bank.
- A key element for investment banks is to contact the right investors who hold information on the security issued and who are interested in the security. This is where the value of investment banks lies, in their ability to reach investors and get them interested in security issues. The network that investment banks develop makes sure the issue attracts sufficient interest for a high price to be achieved.
- → Book-building eliminates the risk to investment banks, but it also exposes them to reputational risk if they seek to sell to their network of investors securities that eventually turn out to be less valuable than initially thoughy.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

→ Book-building does not characterise the entire underwriting process, but it is only one element, although an important element.

- In principle book-building can be used with best-efforts and firm commitment contract, but given that the issue is guaranteed to sell fully, there is no practical difference between the two contract forms. The firm commitment contract is the most common form.
- The price that emerges from the indicative bids of the book-building process is what is used as the basis of the firm commitment contract, thus the offer price the investment bank guarantees is usually only set at a late stage to virtually no risk for the investment bank.
- A key element for investment banks is to contact the right investors who hold information on the security issued and who are interested in the security. This is where the value of investment banks lies, in their ability to reach investors and get them interested in security issues. The network that investment banks develop makes sure the issue attracts sufficient interest for a high price to be achieved.

→ Book-building eliminates the risk to investment banks, but it also exposes them to reputational risk if they seek to sell to their network of investors securities that eventually turn out to be less valuable than initially thoughy.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

→ Book-building does not characterise the entire underwriting process, but it is only one element, although an important element.

- In principle book-building can be used with best-efforts and firm commitment contract, but given that the issue is guaranteed to sell fully, there is no practical difference between the two contract forms. The firm commitment contract is the most common form.
- The price that emerges from the indicative bids of the book-building process is what is used as the basis of the firm commitment contract, thus the offer price the investment bank guarantees is usually only set at a late stage to virtually no risk for the investment bank.
- A key element for investment banks is to contact the right investors who hold information on the security issued and who are interested in the security. This is where the value of investment banks lies, in their ability to reach investors and get them interested in security issues. The network that investment banks develop makes sure the issue attracts sufficient interest for a high price to be achieved.

→ Book-building eliminates the risk to investment banks, but it also exposes them to reputational risk if they seek to sell to their network of investors securities that eventually turn out to be less valuable than initially thoughy.

Copyright © 2024 by Andreas Krause

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

Copyright © 2024 by Andreas Krause

Book-building as one element of the underwriting process

→ Book-building does not characterise the entire underwriting process, but it is only one element, although an important element.

- In principle book-building can be used with best-efforts and firm commitment contract, but given that the issue is guaranteed to sell fully, there is no practical difference between the two contract forms. The firm commitment contract is the most common form.
- The price that emerges from the indicative bids of the book-building process is what is used as the basis of the firm commitment contract, thus the offer price the investment bank guarantees is usually only set at a late stage to virtually no risk for the investment bank.
- A key element for investment banks is to contact the right investors who hold information on the security issued and who are interested in the security. This is where the value of investment banks lies, in their ability to reach investors and get them interested in security issues. The network that investment banks develop makes sure the issue attracts sufficient interest for a high price to be achieved.

→ Book-building eliminates the risk to investment banks, but it also exposes them to reputational risk if they seek to sell to their network of investors securities that eventually turn out to be less valuable than initially thoughy.

Copyright © 2024 by Andreas Krause

This presentation is based on
Andreas Krause: Theoretical Foundations of Investment Banking, Springer Verlag 2024
Copyright © 2024 by Andreas Krause

Picture credits:
Cover: The wub, CC BY-SA 4.0 https://creativecommons.org/licenses/by-sa/4.0, via Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Canary_Wharf_from_Greenwich_riverside_2022-03-18.jpg
Back: Seb Tyler, CC BY 3.0 https://creativecommons.org/licenses/by/3.0, via Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Canary_Wharf_Panorama_Night.jpg

Andreas Krause
Department of Economics
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk