Andreas Krause

Adverse selection

- A common problem in financial markets, corporate finance and banking is that individuals have different information about the value of a security, the risks of a loan or other characteristics.
- Individuals do not only differ in the information they hold, but also how precise this information is.
- We will look at some general properties of such a differences in information precision and how it affects the potential outcome of market interactions between such individuals.

Asymmetric information

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→ Asymmetric information refers to a situation where individuals have information of different quality, that is precision. We will now look at some implications of such asymmetric information.

- It is reasonable to assume that some individuals have better information than others, that is information which is more precise. Such information would be about the relevant properties of a 'good' these individuals are about to exchange, such as between buyers and sellers of securities, or borrowers and lenders (banks).
- If one person is better informed, they will have an advantage and should be able to generate higher profits than the less-well informed individual. To achieve these higher profits they will make use of their better information.
- A trade in itself is a zero-sum game. If the buyer obtains the good at a lower price, he would make a larger profit; on the other hand, the seller obtains a lower price, making smaller profits or a loss. These additional profits and lower profits/losses exactly balance each other.
- If the less-well informed individual knows that he is interaction with a better informed individual and that this will result in a loss, he might not be willing to engage in the transaction at all.

→ Thus this so-called symmetric information, where some market participants are better informed than others, can lead to a situation where transactions cannot occur as the less-well informed individuals do not enter the market.

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Examples of asymmetric information

Examples of asymmetric information

→ Before we look at the specific case of bank lending and how asymmetric might affect the decision by banks,w e look at some common situations of assymmetric information, many outside the area of finance.

- The classical example on which the idea of asymmetric information is built is that of used cars. A used-car dealer will usually have better information on the quality of the car they are selling, they will have inspected the car in detail, and they have knowledge about cars. On the other hand a car buyer will not have this information as they could not inspect the car to the same level of detail and most buyers will lack the knowledge to do so.
- The seller of a property will have a better knowledge of any faults in the property, but also of any concerns about the neighbourhood (neighbours, crime, noise levels, pollution). While buyers can gain some of this information with the help of experts, such as surveys and a questionnaire the seller needs to answer, he will never reach the same level of information.
- When taking out an insurance policy, the policy holder will have better information about their own risks, for example their life style for health insurance or their driving style for car insurance. While insurance companies use many indicators to assess risks, these will never be at the same level as the policy holder itself.
- An investment advisor will have more information about possible investments than their client, that is, afterall, the reason the clients seeks such advice. The investment advisor could use their knowledge to distort their advice towards investments that benefit him through the compensation he receives for his advice from the client. The client would not be able to detect that this advice is not optimal for themselves, but for the advisor.
- When applying for a loan, the company managers will often have better information on the prospects of their company than a bank could have. Companies will know better the market they are operating in as well their competitors.

→ We will now look in more details at the consequences of asymmetric information on bank lending.

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Bank lending

Bank lending

→ We now look at the provision of a loan by a bank to a company, where the bank has less precise information about the risks of the company than the company has about itself.

- For simplicity assume that the risks of a company are either high or low. The high-risk company is less likely to repay the loan than the low-risk company.
- - We assume that the company knows whether into which category if falls, it has high-precision information.
  - Banks have less precise information and do not know which type a company is; they only know the liklihood of a company being low-risk and high-risk, respectively.
- - Banks will be repaid the loan only with some probability, this might be due to companies succeeding with their investments; if the company does not succeed with the investment, it will not be able to repay the loan. We first consider the case where the loan if provided to low-risk companies with high repayment rates.
  - Banks use these proceeds from the loan repayment (if any) to repay the depositors that have been used to finance the loan.
- - We now consider the same scenario, with the only difference being that the companies the bank lends to is high-risk and hence the repayment rate is low.
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- Banks do not know whether the company they are lending to are low-risk or high-risk. The only information they have is the proportion of such companies in the market. They will thus expect to lend to companies of these qualities with the respective probabilities.
- *Formula*
- We can collect terms and rewrite the profits of the bank more comprehensively.
- As a detail, we assume that loans are fully financed by deposits, thus there is no equity used to finance loans, nor do bank retain any cash reserves. This is a simplification of the way banks operate.

→ We have now established the profits that banks make and can proceed to determine the loan rate banks will charge.

Bank lending

- We have two types of companies, one repays a loan with a high probability and the other with a low probability

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Bank lending

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- $\Pi_B = \quad \pi_H(1+r_L)\,L - (1+r_D)\,D \quad + \quad \pi_L(1+r_L)\,L$

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→ We now look at the provision of a loan by a bank to a company, where the bank has less precise information about the risks of the company than the company has about itself.

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Loan rates

Loan rates

→ We can now determine the resulting loan rate in such a situation.

- We assume that banks are competitive, which implies that they make no profits.

⇒ We can solve this condition for the loan rate that banks will charge.

- The loan rate banks charge is based on the average risk of companies , which is the denominator of the expression. This is because banks cannot distinguish between companies of different types.

→ Knowing the loan rate, we can now determine the profits the company achieves.

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Company profits

→ Using this loan rate, we can now determine the profits of the company

- The company sues the proceeds of the loan to make an investment on which they will obtain a given return. The return will depend on the type of investment they conduct, low-risk or high-risk.
- This return is only achieved if the investment is successful. If the investment is not successful, the company obtains no funds from the investment. The success rate will depend on the type of investment made, low-risk or high-risk.
- The company will use the return from the investment to repay the loan. This loan repayment is only possible if the investment is successful as otherwise the company has no funds and limited liability means that banks do not obtain any repayments.

- *Formula*
- We now consider the low-risk company, the company with a high success rate in their investments, and establish the condition under which it would borrow. The low-risk company would only borrow if its is profitable to do so.

⇒ We can solve the condition for the minimum fraction of companies that are low-risk that is required. We have achieved this by inserting for the loan rate thaty banks will charge if they make no profits.

- We thus see that if too many high-risk companies are present in the market, low-risk companies not make a profit.
- This result is arising because with few low-risk companies, the loan rate the bank will charge is high; this high loan rate will exceed the return the company generates from the investment, causing it to make a loss.

→ This result is made more reasonable if we assume that low-risk investments are also yielding a lower return. This is the result of risk-aversion, where the low risk required a low risk premium and hence a low overall return. We will consider this argument further next.

Company profits

- The company invests the loans and obtains a return
- $\Pi_C^i = \quad ((1 + R_i)\, I \qquad\qquad)$

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- The company invests the loans and obtains a return, provided the investment is successful, and then repays the loan
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- Only if sufficient low-risk companies are present, will they make a profit

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- The company will use the return from the investment to repay the loan. This loan repayment is only possible if the investment is successful as otherwise the company has no funds and limited liability means that banks do not obtain any repayments.

- *Formula*
- We now consider the low-risk company, the company with a high success rate in their investments, and establish the condition under which it would borrow. The low-risk company would only borrow if its is profitable to do so.

⇒ We can solve the condition for the minimum fraction of companies that are low-risk that is required. We have achieved this by inserting for the loan rate thaty banks will charge if they make no profits.

- We thus see that if too many high-risk companies are present in the market, low-risk companies not make a profit.
- This result is arising because with few low-risk companies, the loan rate the bank will charge is high; this high loan rate will exceed the return the company generates from the investment, causing it to make a loss.

→ This result is made more reasonable if we assume that low-risk investments are also yielding a lower return. This is the result of risk-aversion, where the low risk required a low risk premium and hence a low overall return. We will consider this argument further next.

Company profits

- The company invests the loans and obtains a return, provided the investment is successful, and then repays the loan
- $\Pi_C^i = \pi_i \left((1 + R_i) I - (1 + r_L) L \right)$
- Low-risk companies borrow if it is profitable: $\Pi_C^H \geq 0$

$\Rightarrow p \geq p^* = \frac{(1+r_D) - \pi_L (1+R_H)}{(\pi_H - \pi_L)(1+R_H)}$

- Only if sufficient low-risk companies are present, will they make a profit
- If less low-risk companies are present, the loan rate is exceeding their investment return

Company profits

→ Using this loan rate, we can now determine the profits of the company

- The company sues the proceeds of the loan to make an investment on which they will obtain a given return. The return will depend on the type of investment they conduct, low-risk or high-risk.
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Borrowing by high-risk companies

Borrowing by high-risk companies

→ We now make some assumptions on the parameters in our model as well as the borrowing of high-risk companies.

▶
- With the afore said, it is reasonable to assume that high-risk companies, those with low success rates, are obtaining a higher return than low-risk companies if they are successful. The reason is that high-risk investments would attract a high risk premium.
- *Formula*

▶
- Let us now assume that that the fraction of low-risk companies is below the threshold for low-risk companies to be profitable.
- This directly implies that low-risk companies would not demand any loans.

▶
- We assume that that high-risk companies obtain a return on their investment which is high enough for them to make profits.
- *Formula*

⇒
- As high-risk companies are profitable, they will demand loans.
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→ We can now look at the consequences for the market in a such a situation.

Borrowing by high-risk companies

- Assume now that high-risk companies have higher returns if successful

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Borrowing by high-risk companies

- Assume now that high-risk companies have higher returns if successful: $R_L > R_H$

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Borrowing by high-risk companies

- Assume now that high-risk companies have higher returns if successful: $R_L > R_H$
- Further assume that $p < p^*$

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- Finally assume that returns for high-risk companies are sufficiently hight such that they are profitable

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$\Rightarrow$ High-risk companies demand loans

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Market breakdown

Market breakdown

→ We will now explain how this situation will lead to a breakdown of the market.

- In this situation, as only high-risk companies demand loans, the loan rate the bank charges is too low. The loan rate was based on the assumption that there was a mix of low-risk and high-risk companies demanding loans, but now there are only high-risk companies demanding loans. As we had the bank breaking when lending to a mix of low-risk and high-risk companies, the bank would not make a loss if only high-risk companies demand a loan. This is because the repayment rate of the high-risk companies is too low and the bank would receive the repayment on the loan not frequently enough to cover the costs of repaying depositors.
- This situation where for a price based on the information of the less-well informed party leads to only one type of better-informed individuals seeking to interact, and this causes losses to the less-well informed party, is called adverse selection.

⇒ As banks make a loss in this case, they would not offer any loans (at least at that price) and no one would be able to obtain a loan, even the high-risk companies for which a loan would be profitable. This is known as a market breakdown.

- If the expected investment return of the low-risk company is above the financing costs, it would increase social welfare if the low-risk companies could obtain a loan.
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- If the expected investment return of the high-risk company is below the financing costs, it would increase social welfare if the high-risk companies could not obtain a loan.
  - *Formula*
- If $p < p^*$ then no loans are given, which is socially not optimal as low-risk companies do not obtain a loan to make the investment.
- If $p \geq p^*$ then both types of companies obtain a loan, which is socially not optimal as high-risk companies should not obtain a loan to make the investment.

→ In both cases there is a welfare loss, either because some companies do not obtain a loan, even though they should; or some companies obtain a loan, even though they should not.

Market breakdown

- If only high-risk companies demand loans, banks charge a too low loan rate to be profitable

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Market breakdown

- If only high-risk companies demand loans, banks charge a too low loan rate to be profitable
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$\Rightarrow$ Banks would not offer any loans and the market breaks down

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- It is socially desirable that low-risk companies obtain loans if their expected return is sufficiently high

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- It is socially desirable that low-risk companies obtain loans if their expected return is sufficiently high: $\pi_H (1 + R_H) \geq 1 + r_D$
- It is socially not desirable that low-risk companies obtain loans if their expected return is sufficiently low

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⇒ As banks make a loss in this case, they would not offer any loans (at least at that price) and no one would be able to obtain a loan, even the high-risk companies for which a loan would be profitable. This is known as a market breakdown.

- If the expected investment return of the low-risk company is above the financing costs, it would increase social welfare if the low-risk companies could obtain a loan.
- *Formula*

- If the expected investment return of the high-risk company is below the financing costs, it would increase social welfare if the high-risk companies could not obtain a loan.
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- If $p < p^*$ then no loans are given, which is socially not optimal as low-risk companies do not obtain a loan to make the investment.
- If $p \geq p^*$ then both types of companies obtain a loan, which is socially not optimal as high-risk companies should not obtain a loan to make the investment.

→ In both cases there is a welfare loss, either because some companies do not obtain a loan, even though they should; or some companies obtain a loan, even though they should not.

Market breakdown

- If only high-risk companies demand loans, banks charge a too low loan rate to be profitable
- This situation is commonly referred to as adverse selection

$\Rightarrow$ Banks would not offer any loans and the market breaks down

- It is socially desirable that low-risk companies obtain loans if their expected return is sufficiently high: $\pi_H (1 + R_H) \geq 1 + r_D$
- It is socially not desirable that low-risk companies obtain loans if their expected return is sufficiently low: $1 + r_D \geq \pi_L (1 + R_L)$

Market breakdown

→ We will now explain how this situation will lead to a breakdown of the market.

- In this situation, as only high-risk companies demand loans, the loan rate the bank charges is too low. The loan rate was based on the assumption that there was a mix of low-risk and high-risk companies demanding loans, but now there are only high-risk companies demanding loans. As we had the bank breaking when lending to a mix of low-risk and high-risk companies, the bank would not make a loss if only high-risk companies demand a loan. This is because the repayment rate of the high-risk companies is too low and the bank would receive the repayment on the loan not frequently enough to cover the costs of repaying depositors.
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Preventing market breakdown

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→ The market breaking down reduces welfare, so we should develop mechanisms to avoid such a scenario.

- We could increase the welfare if banks could distinguish between companies of different types. This would prevent a market breakdown and it would prevent high-risk companies from obtaining a loan in the first place.
- As banks do not hold the information to distinguish between different company types from the information they hold, it would be beneficial to develop a mechanism which gives incentives to companies to reveal their identity, as they know their own type.
- In this specific example of providing loans, the use of collateral is such a mechanism.
- In general, companies can be offered a choice of action and they are freely to choose between them; depending on their type, the ordering of profits will be different for each action. By choosing the optimal action for them, the bank can infer the type of company and decide on their lending accordingly.

→ A lot of the literature in trading, bank lending, and investment banking is concerned about this problem of adverse selection and developing mechanisms to be able to distinguish between different types of individuals.

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