Andreas Krause

Chapter 15.3

Misrepresentation of trading outcomes

Outline

- Problem and model assumptions
- Incentives for traders
- Incentives for managers
- Equilibrium outcome
- Summary

Outline

- Traders in investment banks are commonly remunerated based on their trading performance. If traders are able to exaggerate their trading performance and the investment bank is not able to detect this misrepresentation, the trader receives excessive remuneration.
- We will look at the incentives of traders to misrepresent their performance and at the incentives of banks to detect such misrepresentation.

Outline

- We will look at the incentives of traders to misrepresent their trading performance, but also that of their managers to detect their misrepresentation.
- These incentives will for traders and managers will then combined to obtain the overall equilibrium of traders misrepresenting their trading outcomes.

- Problem and model assumptions
- Incentives for traders
- Incentives for managers
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- Summary

- We will first set out the basic framework for the model we will analyze.

Hiding losses and reporting profits

Hiding losses and reporting profits

→ Traders being remunerated based on their trading performance will have an incentive to inflate the performance they report.

- - A trader making losses will usually not receive a bonus payment due to their low trading performance, and if such losses occur regularly might be at risk of being made redundant by the investment bank.
  - Even if traders are generating profits, their they might want to report larger profits as this would increase their remuneration.
- - Of course, increasing the trading performance can be achieve by outright fraud, such as not reporting loss-making trades and only reporting those trades that are profitable. However, where the remuneration is taking into account the risks a trader takes, it might also be achieved by under-reporting the risks they are taking to achieve the trading profits they generated.
  - Another way to achieve higher profits is by not (yet) recognising losses, for example by delaying closing a sale or using derivatives to move losses into the next time period. This would increase the reported profits in the current time period, securing a higher bonus; the trader will then hope that the losses carried over to the next time period can be compensated for by making higher trading profits in the future.
  - Similarly, a trader might bring forward profits for the same reason, for example by reporting profits that have not yet been realised, such as on positions that are yet to be closed.
- In all cases the ultimate aim of traders is to increase their remuneration, which is based on their trading performance; in some instances this might also be an attempt to retain their job.

→ There are clear benefits for traders to misrepresent their trading performance.

Hiding losses and reporting profits

- Traders may hide losses from trading

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- Apart from fraud, this might be achieved by underreporting risks, delaying the realisation of losses

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Reporting the value of trading positions

Reporting the value of trading positions

→ We will now look at how traders benefit from such misrepresentations of their trading outcomes.

- Let us assume that the value of a trader's position, for example his profits, are either high or low and only the trader knows the actual outcome, their manager and the investment bank will only know the probability with which each value will be realised.
- The wages of traders are set such that they receive a fraction of the value of their position.
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  - The actual outcome is not known or easily verifiable by the investment bank and therefore the trader can report either value.
  - We assume now that he misrepresents his outcome, that is reports an outcome different to the one he actually received, with some probability. We will determine this probabiity endogenously as the equilibrium.
- Managers will be able to monitor the behaviour of their traders and if they decide to monitor, they will detect the misrepresentation. Similarly, the investment bank may undergo a detailed audit, in which case the misrepresentation will be detected as well, even if the manager did not monitor the trader.

→ Traders will receive a fraction of the value they report as their remuneration and hence have an incentive to always report the highest possible outcome. However, if they are monitored or the investment bank is audited, their misrepresentation will be found out. If there is a penalty for misrepresenting the outcome, we see that traders will balance the higher remuneration against the penalty if detected.

Reporting the value of trading positions

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Reporting the value of trading positions

- The position of a trader is worth V_H with probability π, or $V_L < V_H$ otherwise
- Traders are remunerated with a fraction w_T of this value
- A trader can report any value, regardless of the actual outcome

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- We first look at the incentives traders have to misrepresent their trading outcomes.

Outcomes for traders

Outcomes for traders

→ We will see how traders are affected if they misrepresent the outcome of their trading and this is detected.

- If a trader has realised the high outcome, he has no incentive to misrepresent it as being low as that would reduce his remuneration and subject him to any penalties from this misrepresentation. We will therefore focus only on traders that have realised the low outcome.
- A trader reporting the low value truthfully will receive a fraction of this value as his remuneration.
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  - A misrepresentation is detected if the trader is monitored by his manager, which we assume happens with probability λ_M.
  - A misrepresentation is also detected if the investment bank overall is audited, which we assume happens with probability λ_A.
- We assume that if a misrepresentation is detected, the trader forfeits its remuneration and pays a 'fine'.
- This fine could be the costs of his dismissal, the reduction in future bonuses, or any clawback of bonuses previously paid.

→ We can now determine the profits of the trader misrepresenting its outcome.

Outcomes for traders

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- Their misrepresentation will be caught if the manager monitors (probability λ_M)

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- Their misrepresentation will be caught if the manager monitors (probability λ_M) or an audit takes place (probability λ_A)
- If misrepresentation is detected, they are fined F_T and receive no remuneration

Outcomes for traders

→ We will see how traders are affected if they misrepresent the outcome of their trading and this is detected.

- If a trader has realised the high outcome, he has no incentive to misrepresent it as being low as that would reduce his remuneration and subject him to any penalties from this misrepresentation. We will therefore focus only on traders that have realised the low outcome.
- A trader reporting the low value truthfully will receive a fraction of this value as his remuneration.
- If they misrepresent their outcome as being of high value instead, they will receive a fraction of this higher value, provided their misrepresentation is not detected.
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  - A misrepresentation is detected if the trader is monitored by his manager, which we assume happens with probability λ_M.
  - A misrepresentation is also detected if the investment bank overall is audited, which we assume happens with probability λ_A.
- We assume that if a misrepresentation is detected, the trader forfeits its remuneration and pays a 'fine'.
- This fine could be the costs of his dismissal, the reduction in future bonuses, or any clawback of bonuses previously paid.

→ We can now determine the profits of the trader misrepresenting its outcome.

Outcomes for traders

- Assume the low value V_L is realised
- If reporting the value truthfully, traders receive $\Pi_T = w_T V_L$
- If they do not report truthfully, they might receive $w_T V_H$
- Their misrepresentation will be caught if the manager monitors (probability λ_M) or an audit takes place (probability λ_A)
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Trader profits with misrepresentation

Trader profits with misrepresentation

→ We can now determine the profits of traders if they misrepresent their trading outcome.

- If the trader is monitored by its manager, then the misrepresentation is detected and the trader makes a loss due to the fine being paid.
- In case the manager does not monitor its traders, the investment bank might be audited and if such an audit takes place, the trader makes a loss due to the fine being paid.
- If neither the manager monitors the trader and the investment bank is not audited, the trader will receive his remuneration based on the outcome he claimed to have received.
- *Formula*

→ We can now compare the profits of a trader misrepresenting the outcome with that of a trader reporting the lower outcome truthfully.

Trader profits with misrepresentation

- If the trader is monitored by his manager, he is fined F_T
- Trader profits: $\hat{\Pi}_T = -\lambda_M F_T$

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Trader profits with misrepresentation

- If the trader is monitored by his manager, he is fined F_T
- If the trader is not monitored, he will be fined F_T if an audit takes place

- Trader profits: $\hat{\Pi}_T = -\lambda_M F_T + (1 - \lambda_M)(-\lambda_A F_T$

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- Trader profits: $\hat{\Pi}_T = -\lambda_M F_T + (1-\lambda_M)\left(-\lambda_A F_T + (1-\lambda_A) w_T V_H\right)$

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Truthful reporting

Truthful reporting

→ We now determine the condition for traders to report their trading outcome truthfully.

- The outcome is truthfully reported if it is more profitable to do so than misrepresent the outcome.
- This condition can be solved for the *formula*.
- We clearly see that traders report outcomes truthfully if the likelihood of the manager monitoring them is sufficiently high, thus the likely hood of them being detected is sufficiently high.

→ We can now turn our attention to the manager and its incentives to monitor the trader.

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- Problem and model assumptions
- Incentives for traders
- Incentives for managers
- Equilibrium outcome
- Summary

- Managers can detect that traders misrepresent their trading outcomes by monitoring their activities. Such monitoring will be costly to the manager, but not fulfilling his duties to detect any misrepresentations may also lead to them being fined.
- we will therefore look in detail at the incentives of managers to monitor traders.

Outcome for managers with monitoring

Outcome for managers with monitoring

→ We will first determine the profits managers make if they monitor the trader.

- We assume that managers receive a fraction of the trading outcome the trader reports. This is similar to the remuneration of the trader and might be interpreted as the manager receiving a fraction of the profits generated by the trading desks under his supervision.
- If the manager monitors, he will face costs of doing so.
- We assume that traders misrepresent their outcomes with some probability p.
- The high outcome is realised with some probability and the trader will truthfully report this outcome, giving the manager the remuneration in the *formula*.
- The low outcome is realised with the complementary probability and the trader will either truthfully report this outcome or if not truthful the manager will detect this and adjust the trading outcome accordingly, giving the manager the remuneration in the *formula*. Whether the trading outcome is misrepresented or not does not affect the manager.
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→ We can now look at the remuneration the manager receives if he does not monitor the trader.

Outcome for managers with monitoring

- Managers receive a fraction w_M of what a trader declares

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Outcome for managers with monitoring

- Managers receive a fraction w_M of what a trader declares
- Monitoring traders costs C
- Traders misrepresent a low value V_L as V_H with probability p
- If the high outcome is realised, the manager gets $w_M V_H - C$

- $\Pi_M = \pi \left(w_M V_H - C \right)$

Outcome for managers with monitoring

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Outcome for managers with monitoring

- Managers receive a fraction w_M of what a trader declares
- Monitoring traders costs C
- Traders misrepresent a low value V_L as V_H with probability p
- If the high outcome is realised, the manager gets $w_M V_H - C$
- If the low outcome is realised, he will receive $w_M V_L - C$
- $\Pi_M = \pi \left(w_M V_H - C \right) + \left(1 - \pi \right) \left(w_M V_L - C \right)$

Outcome for managers with monitoring

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→ We can now look at the remuneration the manager receives if he does not monitor the trader.

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- Managers receive a fraction w_M of what a trader declares
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→ We can now look at the remuneration the manager receives if he does not monitor the trader.

Outcome for managers without monitoring

Outcome for managers without monitoring

→ We will now look at the payments the manager receives if he is not monitoring the trader. He will of course not incur any monitoring costs in this case.

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  - If the trader misrepresent his trading outcome and the manager does not detect this as he does not monitor the trader, he will receive a fine. This is similar to the fine the trader receives if it is detected that he has misrepresented his trading outcome.
  - Such a fine is only imposed if the investment bank is audited and the misrepresentation of the trader is detected. Without an audit no misrepresentation can be detected and hence no fine be imposed.
- If the trader realises the high outcome, he will report this truthfully and in this case the manager will receive his fraction of this trading outcome.
- If the low outcome is realised, the trader might misrepresent it, which we assumed to happen with probability p. If the investment bank is audited this misrepresentation is found out and the manager fined for not detecting it. If the investment bank is not audited, the misrepresentation is not detected and the manager receives his payment based on the reported higher outcome.
- With probability $1 - p$ the trader doe snot misrepresent his trading outcome and the manager will therefore receive his fraction of this lower trading outcome. As the outcome is not misrepresented, it is irrelevant whether the investment bank is audited or not.
- *Formula*

→ We can now compare the profits to the manager with and without monitoring the trader.

Outcome for managers without monitoring

- If traders misrepresent the outcome and the manager does not monitor, he will be fined F_M

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Outcome for managers without monitoring

- If traders misrepresent the outcome and the manager does not monitor, he will be fined F_M if an audit detects this

Outcome for managers without monitoring

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Outcome for managers without monitoring

- If traders misrepresent the outcome and the manager does not monitor, he will be fined F_M if an audit detects this
- If the high outcome is realised, he receives $w_M V_H$

- $\hat{\Pi}_M = \pi w_M V_H$

Outcome for managers without monitoring

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→ We can now compare the profits to the manager with and without monitoring the trader.

Outcome for managers without monitoring

- If traders misrepresent the outcome and the manager does not monitor, he will be fined F_M if an audit detects this
- If the high outcome is realised, he receives $w_M V_H$
- if the low outcome is realised, and outcome is misrepresented, then is fined F_M if an audit takes place, without an audit receives $w_M V_H$

- $\hat{\Pi}_M = \pi w_M V_H + (1-\pi)\left(p\left(-\lambda_A F_M + (1-\lambda_A) w_M V_H\right)\right)$

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→ We can now compare the profits to the manager with and without monitoring the trader.

Outcome for managers without monitoring

- If traders misrepresent the outcome and the manager does not monitor, he will be fined F_M if an audit detects this
- If the high outcome is realised, he receives $w_M V_H$
- if the low outcome is realised, and outcome is misrepresented, then is fined F_M if an audit takes place, without an audit receives $w_M V_H$
- If the outcome is not misrepresented, he receives $w_M V_L$
- $\hat{\Pi}_M = \pi w_M V_H + (1-\pi)\left(p\left(-\lambda_A F_M + (1-\lambda_A) w_M V_H\right) + (1-p) w_M V_L\right)$

Outcome for managers without monitoring

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→ We can now compare the profits to the manager with and without monitoring the trader.

Outcome for managers without monitoring

- If traders misrepresent the outcome and the manager does not monitor, he will be fined F_M if an audit detects this
- If the high outcome is realised, he receives $w_M V_H$
- if the low outcome is realised, and outcome is misrepresented, then is fined F_M if an audit takes place, without an audit receives $w_M V_H$
- If the outcome is not misrepresented, he receives $w_M V_L$
- $\hat{\Pi}_M = \pi w_M V_H + (1-\pi)\left(p\left(-\lambda_A F_M + (1-\lambda_A) w_M V_H\right) + (1-p) w_M V_L\right)$

Outcome for managers without monitoring

→ We will now look at the payments the manager receives if he is not monitoring the trader. He will of course not incur any monitoring costs in this case.

-
  - If the trader misrepresent his trading outcome and the manager does not detect this as he does not monitor the trader, he will receive a fine. This is similar to the fine the trader receives if it is detected that he has misrepresented his trading outcome.
  - Such a fine is only imposed if the investment bank is audited and the misrepresentation of the trader is detected. Without an audit no misrepresentation can be detected and hence no fine be imposed.
- If the trader realises the high outcome, he will report this truthfully and in this case the manager will receive his fraction of this trading outcome.
- If the low outcome is realised, the trader might misrepresent it, which we assumed to happen with probability p. If the investment bank is audited this misrepresentation is found out and the manager fined for not detecting it. If the investment bank is not audited, the misrepresentation is not detected and the manager receives his payment based on the reported higher outcome.
- With probability $1-p$ the trader doe snot misrepresent his trading outcome and the manager will therefore receive his fraction of this lower trading outcome. As the outcome is not misrepresented, it is irrelevant whether the investment bank is audited or not.
- *Formula*

→ We can now compare the profits to the manager with and without monitoring the trader.

Monitoring incentives

→ We can now determine the condition under which managers monitor their traders.

- The manager will monitor if he receives higher payment from doing so than form not monitoring.
- This condition can be solved for this *formula*.
- We see that if traders are sufficient likely to misrepresent their trading outcomes, then managers will monitor them. If traders are more likely to misrepresent their outcomes, managers not monitoring their traders will more often being fined as the audir of the investment bank will detect such misrepresentations more often; this increases the incentives of managers to monitor their traders and avoid the fine.

→ We can now combine these results on the incentives of traders and managers.

Monitoring incentives

- Managers will monitor if $\Pi_M \geq \hat{\Pi}_M$

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- Problem and model assumptions
- Incentives for traders
- Incentives for managers
- Equilibrium outcome
- Summary

- Having determined the incentives of traders to report their outcome truthfully and for managers to monitor traders, we can now combine these two results and determine the equilibrium likelihood of traders misrepresenting their trading outcomes.

Equilibrium monitoring and misrepresentation

Equilibrium monitoring and misrepresentation

→ We can now assess the equilibrium outcome by considering the consequences of monitoring for misrepresentations and vice versa.

- - We know from our results above that is managers monitor sufficiently frequently, traders will always report their outcome s truth fully.
  - The probability of misrepresenting outcomes by traders is then zero.
- - If traders never misrepresent their outcome, we can easily see that the profits of managers monitoring their traders are lower.
  - In this case, managers would never monitor their traders.
- - We then see that if no monitoring occurs, it is optimal for traders to misrepresent their outcomes,
  - The probability of misrepresenting outcomes by traders is then one.
- As $p > p^*$ this would then make it profitable for managers to monitor traders, $\lambda_M = 1 > \lambda_M^*$. Hence the cycle would start again.
- The only possible equilibrium is if monitoring by managers and misrepresenting the outcome by traders are at the critical level where they are indifferent between their two respective options.

→ Having established the equilibrium level os misrepresentation of outcomes and monitoring of traders, we can now focus on the relationship between these two.

Equilibrium monitoring and misrepresentation

- If $\lambda_M > \lambda_M^*$, traders report truthfully

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- If $\lambda_M > \lambda_M^*$, traders report truthfully, hence $p = 0$

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Equilibrium misrepresentation of outcomes

Equilibrium misrepresentation of outcomes

→ We can now analyse the equilibrium probability with which traders misrepresent their outcomes.

- We can solve the equilibrium condition for managers, λ_M^*, for the probability of an audit occurring and insert this expression into the likelihood of traders misrepresenting their outcomes.
- *Formula*
-
  - As this expression is clearly positive, we see that in equilibrium traders misrepresent outcomes.
  - The level of misrepresentation is reducing in the level of monitoring by managers, λ_M^*.
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  - As the original representation for p^* shows, a higher likelihood of an audit being conducted reduces the frequency with which traders misrepresent outcomes.
  - As we see from the definition of λ_M^*, audits also reduce the incentives of managers to monitor their traders. This is because the effect it has on the probability of traders misrepresenting their outcomes; with auditing increasing, the likelihood of misrepresentations being detected increases which makes them less attractive. This in turn allows managers to reduce their monitoring effort, reducing the effect of an increased audit probability.
  - While monitoring and audits are substitutes, they are imperfect substitutes due to the incentives of managers to monitor their traders.

→ We thus see that in equilibrium, traders will be misrepresenting their outcomes.

Equilibrium misrepresentation of outcomes

- We can combine these equilibrium conditions

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Equilibrium misrepresentation of outcomes

- We can combine these equilibrium conditions
- $p^* = \frac{\left(1-\lambda_M^*\right)(F_T+w_T V_H)C}{(1-\pi)(F_M+w_M V_H)\left(w_T(V_H-V_L)-\lambda_M^*(F_T+w_T V_H)\right)}$

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- Misrepresentations happen in equilibrium, but is reducing in monitoring

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- Misrepresentations happen in equilibrium, but is reducing in monitoring
- Auditing reduces misrepresentations directly

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- Problem and model assumptions
- Incentives for traders
- Incentives for managers
- Equilibrium outcome
- Summary

- We can now look at some of the implications these results have.

Incentives to misrepresent outcomes

Incentives to misrepresent outcomes

→ Traders will always have some incentive to misrepresent the outcome of their trading activities to obtain higher remunerations.

- - We have seen that traders have an incentive to misrepresent the outcomes of their trading activities.
  - Such incentives cannot be eliminated completely as monitoring by managers is costly and they will balance the benefits of doing so against their costs of conducting this monitoring.
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- We can thus conclude that under realistic conditions, misrepresentations of trading outcomes will inevitably occur.
- The participation of managers in the declared trading profits of traders gives them a limited incentive to monitor their traders as this will affect their own remuneration if the trading outcome is downgraded.
- Thus managers of trading desks are complicit in these misrepresentations as they have a limited interest in reducing such behaviour, given they benefit from it.

→ Hiding trading losses, exaggerating trading profits are an inevitable result of rewarding traders and their manager based on their trading profits and the difficulty in detecting any misrepresentations.

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