



Chapter 15.2

Remuneration of traders

Outline

- Problem and model assumptions
- Independent traders
- Fixed wages
- Performance wages
- Optimal trader remuneration
- Summary

- Traders typically receive a very low base salary and their remuneration consists mainly of a bonus which is linked to their trading performance.
- We will here look into the optimal structure of their remuneration by comparing fixed wages with remuneration based on their trading performance.

- After setting out the basic set-up of the model, we will determine the profits traders can make if working independently from investment banks.
- We will then explore the optimal remuneration of traders employed by investment banks, looking at fixed wages and remuneration that is linked to their performance. This will then lead us to look at the optimal remuneration for traders.

■ Problem and model assumptions

■ Independent traders

■ Fixed wages

■ Performance wages

■ Optimal trader remuneration

■ Summary

- We will first look at the differences between independent traders and traders employed in investment banks and introduce the basic modelling assumptions.

Traders as employees

- ▶ Investment banks' trading desks employ traders, who require remuneration
- ▶ Traders can be informed or uninformed, the investment bank will not be able to determine this when employing them
- ▶ Investment banks commonly remunerate traders based on their performance rather than on fixed salaries
- ▶ This is often seen as an incentive device to exert effort, but also leads to moral hazard in risk-taking
- ▶ It might be the most profitable way of paying traders

- Traders can be acting independently and trade on their own account, or they can be employed by investment banks to trade on their behalf.
- ▶
 - While independent traders exist, the majority of traders in financial markets are employed by investment banks. By traders here we refer to professional traders, thus exclude those who trade for investment purposes or who supplement their income by conducting some trade, all traders here are assumed to be full-time traders.
 - Of course, as employees at investment banks, traders require a salary. It is of interest here how this salary is determined.
- ▶
 - We assume that there are two types of traders, informed traders and uninformed traders.
 - The investment bank employing traders will not know which type of trader they are hiring, although their type might be revealed at a later stage due to their success or failure in generating trading profits.
- ▶
 - It is common for investment bank to determine the majority the of payment traders receive based on their trading performance, mostly their trading profits. Returns or risk-adjusted returns are less commonly chosen for this purpose, but would in principle lead to the same results.
 - Fixed salaries, like most employees outside of investment banks are paid, are rare for traders.
- ▶
 - The common explanation of this observation is that by linking their remuneration to their trading profits, traders will be motivated to exert high levels of efforts to generate profits for their employer, reducing the moral hazard in this respect.
 - It is also documented that this increases the risks these traders take as they can gain large bonuses if generating high profits, but their bosnus has a lower limit of zero if making large losses.
- ▶ Balancing these two effects, it might be seen as the most profitable way for the investment bank to employ traders.
- We will explore a model to determine the optimal remuneration of traders without resorting to moral hazard.

Trader types

- ▶ Traders are informed with probability γ
- ▶ Informed traders know the change in value of the security, ΔV , uninformed traders know its expected value $E[\Delta V] = 0$ and variance $Var[\Delta V] = \sigma_V^2$
- ▶ Noise traders trade for exogenous reasons with expected trading demand $E[U] = 0$ and variance $Var[U] = \sigma_U^2$

- We have three types of traders, informed and uninformed traders, and now also introduce noise traders.
- ▶ We assume that there is a fraction γ of informed traders in the market, thus the probability of hiring an informed trader or of an informed trader being involved in a specific trade will be γ .
- ▶
 - We assume that informed traders have perfect information in that they know the future change in the value of the asset they are trading with certainty.
 - Uninformed traders do not know this change with certainty, but they expect no change (a normalisation, we can allow for a positive trend), and the variance of the change is also known.
- ▶
 - In addition, we have noise traders. Noise traders are not seeking to maximize an objective function, but they might trade for other reasons. This might be a sale of the asset to obtain liquidity prior to making the purchase of a consumption good and in the process the price they obtain for the asset is of no importance. A purchase of asset might be the consequence of having excess liquid funds that seek investment. For institutional investors regulatory constraints might also force the sale or purchase of assets, for example to meet investment requirements.
 - The demand of noise traders is assumed to be random, a positive demand implies the asset is bought and a negative demand that the asset is sold. We assume that on average the demand of noise traders to buy and sell is balanced, but it has some variance.
- These three types of traders will jointly submit their trading demands to the market and a price will be determined based on this aggregate demand.

Price setting

- ▶ The price is set such that it mirrors the inference of the change in the value, given the demand: $\Delta P = E[\Delta V|D]$
- ▶ The relationship is assumed to be linear: $\Delta P = \lambda D$
- ▶ This is a regression of the demand on the price change, the coefficient being $\lambda = \frac{Cov[\Delta V, D]}{Var[D]}$

- Trades are submitted anonymously, it is hence not possible to distinguish the types of traders and the price set can only be based on the total demand by all traders together.
- ▶
 - The price is set such that the change in price reflects the change in the value of the asset, given the demand observed. The demand is informative as informed traders will submit their orders and then submitting a large buy (sell) order, would imply that the value has increased (decreased). This larger buy (sell) order, makes it more likely that the total demand is positive (negative) and hence the total demand will convey some of the information informed traders have, although the information will not be revealed perfectly.
 - *Formula*
- ▶ We assume that the relationship between the price change and the aggregate demand is linear.
- ▶
 - This relationship can be interpreted as a regression equation, where the price change is explained by the demand and any deviations will be unexplained differences arising from the randomness of the demand by noise traders. We can thus treat this equation as a linear regression equation, without a constant.
 - We know from statistics that the coefficient of this regression will be given by this *formula*.
- Using this framework we can now continue to analyse the behaviour of traders and the profits they generate.

■ Problem and model assumptions

■ Independent traders

■ Fixed wages

■ Performance wages

■ Optimal trader remuneration

■ Summary

- We first consider a trader which is not employed by an investment bank but works independently.

Trader profits

- ▶ A trader not employed by an investment bank can trade independently and faces a trading fee f
- ▶ If the trader is uninformed he will not trade as he will not make a profit against informed traders, $Q_U = 0$
- ▶ Total demand is then $D = Q_I + U$
- ▶ Trading profits: $\Pi_T = E[(\Delta V - (1 + f) \Delta P) Q_I | \Delta V] = (\Delta V - (1 + f) \lambda Q_I) Q_I$

- We can now determine the profits the independent traders.
 - ▶
 - As an independent trader, he is not subject to the remuneration the investment bank pays, but will retain all profits he generates.
 - For his trading he faces a trading fee, consisting of the broker fee, as well as costs of the trading infrastructure, such as computing facilities.
 - ▶
 - We propose that an uninformed trader will not submit a trade.
 - We know from adverse selection that an uninformed trader will not be able to make profits due to the presence of informed traders in the market. If we assume the trader knows his type, thus knows he is uninformed, his trading demand will be nil.
 - ▶ Addressing the demand of informed traders later, we have that the total demand in the market is given by informed traders and noise traders.
 - ▶ The profits of the traders are then only the profits of the informed traders, given that uninformed traders do not trade. These profits would then consist of the change in value of the asset, less the change in the price (the amount the price moved from its previous level), adjusted for the trading fee the trader has to pay. As the informed trader knows the change in the value of the asset, this value can be used and we can use that the expected demand by noise traders is nil and insert for the price change to obtain the *formula*.
- We can now use these profits to determine the demand of informed traders.

Optimal demand

- ▶ Traders will maximize their profits with first order condition $\frac{\partial \Pi_I}{\partial Q_I} = 0$
- ▶ Optimal demand: $Q_I = \frac{\Delta V}{2(1+f)\lambda}$
- ▶ Profits: $E[\Pi_T] = \frac{\sigma_V^2}{4(1+f)\lambda}$

- Informed traders will submit orders such their profits are maximized.
- ▶ The optimal demand is given where the profits are maximized.
- ▶ Solving the first order condition gives the optimal demand as given in the *formula*.
- ▶ We can then insert this expression into the profits of the trader and obtain the profits given the known value change of the asset. This value change is not known in advance when deciding to become an independent trader and hence we use the expected profits of the trader, which gives the results in the *formula*.
- We have thus established the profits independent traders make and compare these profits with the remuneration traders obtain when they are employed by an investment bank.

■ Problem and model assumptions

■ Independent traders

■ Fixed wages

■ Performance wages

■ Optimal trader remuneration

■ Summary

- We will first consider the case where traders are paid a fixed wage by the investment bank.

Demand for employed traders

- ▶ Investment banks will pay enough to induce informed traders to join them:
 $w = E[\Pi_T]$
- ▶ Uninformed traders cannot be identified, hence will also be hired and will trade as to not be detected
- ▶ They will assume the change in security value to be $\Delta \hat{V}$
- ▶ Traders at the investment bank do not face trading costs, thus $f = 0$
- ▶ For informed traders: $Q_I = \frac{\Delta V}{2\lambda}$
- ▶ For uninformed traders: $Q_U = \frac{\Delta \hat{V}}{2\lambda}$

- We will look at the trading demand for employed traders first.
- ▶ The fixed wage the investment bank pays will have to be at least as attractive as becoming an independent trader. The investment bank would not be willing to pay more than this minimum requirement and the wage would be set the level of profits an independent trader would make.
- ▶
 - The investment bank cannot identify the type of trader.
 - Therefore the investment bank will employ both types of traders and the uninformed trader will not identify himself by refusing to trade as regardless of the result of his trading activity, will be paid the fixed wage. By not trading, he would be identified as being uninformed and unlikely to be employed in the future. Hence he will trade in the same way as informed traders.
- ▶ Uninformed traders have no information on the change of the value, so will simply pretend to have received information suggesting some change.
- ▶
 - We assume that traders at investment banks face no trading costs. This can be justified by any broker fee being paid to another department within the investment bank and information systems being fixed costs that cannot be allocated properly to individual trades,
 - Hence we can neglect the trading fee,
- ▶ We still assume that despite being paid a fixed fee the traders seek to maximize the profits they generate from trading. This for informed traders the optimal demand will be identical to that of independent traders, ignoring the trading fee.
- ▶ Uninformed traders will copy the behaviour of informed traders and submit the same orders, based on their assumed change of the asset value.
- Knowing the demand of traders in investment banks, we can now determine the total demand in the market.

Total demand

- ▶ If an informed trader is not employed, he will demand $\hat{Q}_I = \frac{\Delta V}{2(1+f)\lambda}$
- ▶ Trading demand arises if the informed trader is employed, or the uninformed trader is employed, with the informed trader acting independently, plus noise traders
- ▶ $D = \gamma Q_I + (1 - \gamma) (Q_U + \hat{Q}_I) + U$

- We can now determine the aggregate demand of all traders in the market.
- ▶ The demand of independent informed traders we had established above, this is reproduced here.
- ▶
 - The demand in the market consists of the fraction of traders that are informed and are employed by the investment bank. The remaining uninformed traders will not trade independently.
 - It further consists of the fraction of traders that are uninformed and are employed by the investment bank.
 - The remaining informed traders will trade independently if the uninformed trader is employed.
 - In addition we have the demand of the noise traders.
- ▶ *Formula*
- Having obtained the demand for the asset, we can now determine its equilibrium price.

Equilibrium pricing

- ▶ Uniformed traders cannot infer security values: $Cov [\Delta V, \Delta \hat{V}] = 0$ and $Var [\Delta V] = Var [\Delta \hat{V}]$
- ▶ They will trade randomly giving the impression having received $\Delta \hat{V}$
- ▶ This gives $Cov [\Delta V, D] = \frac{\sigma_V^2(1+\gamma f)}{2(1+f)\lambda}$ and $Var [D] = \frac{\sigma_V^2(1+\gamma f)^2}{4(1+f)^2\lambda^2} + \frac{(1-\gamma)^2}{4\lambda^2} + \sigma_U^2$
- ▶ Solving for $\lambda = \frac{1}{2} \frac{\sigma_V}{\sigma_U} \sqrt{2 \frac{1+\gamma f}{1+f} - \left(\frac{1+\gamma f}{1+f} \right)^2 - (1-\gamma)^2}$

- We now see how the behaviour of uninformed traders employed by the investment bank affect the equilibrium prices that emerge.
 - ▶
 - Uninformed traders have no knowledge of the true change in the value of the asset.
 - Uninformed traders will choose their 'assumed' change in the asset value randomly and there will be no correlation to the true change in the asset value as known by the informed traders. We further assume that they will make their assumption randomly from the same distribution as the true asset value change, thus the variances will be identical.
 - ▶ Uninformed traders will choose a random change of asset value and hence their trading demand will be random as well.
 - ▶ These *formulae* now give the covariance of the change in asset value and the demand as well as the variance of the demand.
 - ▶ Using the definition of λ from above we can determine its value. Using that $\Delta P = \lambda D$ we can thus determine the price change.
- Knowing how prices change, we can now determine the profits that investment banks obtain when employing traders.

Investment bank profits

- ▶ Trading profits are from the profits of informed traders and losses of uninformed traders
- ▶ $\Pi = \gamma E [(\Delta V - \Delta P) Q_I | \Delta V] + (1 - \gamma) E [(\Delta V - \Delta P) Q_U]$
- ▶ Profits: $\Pi_B = E [\Pi] - w = \left(\gamma - \frac{1}{2} \frac{2+f}{1+f} \right) \frac{\sigma_U \sigma_V}{\sqrt{2 \frac{1+\gamma f}{1+f} - \left(\frac{1+\gamma f}{1+f} \right)^2 - (1-\gamma)^2}}$

- The profits of investment banks are now given by the profits made by the traders the investment bank employs, less the fixed wages they are paid.
 - ▶
 - The trading profits of investment banks are generated from those of informed traders. The profits are the differences in the changes of the value and the price, giving the profits per unit traded and the demand by the fraction of informed traders, given their information on the true value of the change in the asset value.
 - These profits from informed traders are at least partially offset by the losses that uninformed traders make. The profits are the differences in the changes of the value and the price, giving the profits per unit traded and the demand by the fraction of uninformed traders. Uninformed traders do not know the change in the asset value and no inferences can therefore be made.
 - ▶ *Formula*
 - ▶
 - We then get the profits the investment bank expects to make as the expected profits their traders generate, less the fixed wages they pay.
 - We can insert for all expressions and obtain this *formula*.
- We can now investigate whether conducting proprietary trading is profitable for investment banks.

Operating a trading desk

- ▶ Investment banks will only operate a trading desk if $\Pi_B \geq 0$
- ▶ This requires $\gamma \geq \frac{1}{2} \frac{2+f}{1+f}$
- ▶ We need sufficient informed traders that trade profitably to ensure the losses made by uninformed traders are covered
- ▶ For reasonably low trading costs f , this threshold is very high

- Investment banks are not required to conduct proprietary trading; we will therefore look at conditions where they will do so.
- ▶ Investment banks will operate a trading desk, thus conduct proprietary trading by employed traders, only if it is profitable to do so.
- ▶ We see that the second term in the profits of the investment bank is always positive and hence require the first brackets term to be positive which gives the *formula*.
- ▶ Proprietary trading will only be conducted if the investment bank can employ a sufficiently large number of informed traders that compensate them for the losses that uninformed traders cause.
- ▶ If the trading costs are low, as is realistic in most cases, the second fraction is close to 2 and hence the overall threshold for informed traders close to 1, putting a high threshold on the ability of investment banks to hire informed traders.
- While the model suggests a distinction between informed and uninformed traders, we can also interpret this assumption as competent and less able traders. Furthermore, investment banks will have some ability to distinguish between competent and less able traders during the recruitment process. It will thus be reliant on their ability to identify competent traders with sufficient precision and not employing too many less able traders.

■ Problem and model assumptions

■ Independent traders

■ Fixed wages

■ Performance wages

■ Optimal trader remuneration

■ Summary

- Having established the requirements for investment banks to operate a trading desk when paying traders a fixed wage, we now assume that traders are paid based on the profits they are generating.

Total demand

- ▶ Investment banks will only pay traders according to the profits they make
- ▶ Informed traders will receive a schedule that induces them to join the investment bank
- ▶ Uniformed traders will not trade as they make losses
- ▶ Total demand is from the informed traders employed by the investment bank, informed traders not employed, and noise traders
- ▶ $D = \gamma Q_I + (1 - \gamma) \hat{Q}_I + U$

- If traders are paid according to their profits, the trading demand by uninformed traders will change.
- ▶ Investment banks will pay traders not a fixed wage, but will pay them according to the profits they generate.
- ▶ The amount paid will be identical to the profits they would make as independent traders to induce them to join the investment bank.
- ▶ As uninformed traders would make a loss from trading, they will not trade, even when employed as they would not receive any remuneration in either case.
- ▶
 - Hence the demand for the asset is derived from the fraction of informed traders the investment bank employs,
 - and those the investment bank does not employ and they are trading independently, as the investment bank has hired an uninformed traders instead.
 - We also have the demand of the noise traders.
- ▶ *Formula*
- We can now determine the trading profits of the investment bank.

Trading profits

- ▶ We get $Cov[\Delta V, D] = \sigma_V^2 \frac{1+\gamma f}{2(1+f)\lambda}$ and $Var[D] = \sigma_V^2 \frac{(1+\gamma f)^2}{4(1+f)^2 \lambda^2} + \sigma_U^2$
- ▶ Solving for $\lambda = \frac{1}{2} \frac{\sigma_V}{\sigma_U} \frac{\sqrt{(1+\gamma f)(2(1+f) - (1+\gamma f))}}{1+f}$
- ▶ Trading profits are from the informed traders employed: $\Pi = \gamma (\Delta V - \Delta P) Q_I$

- Using the demand of traders, we can now determine the trading profits of investment banks.
- ▶ We can use this demand again to obtain the covariance between the change in the value of the asset and the demand, as well as the variance of the demand.
- ▶ Inserting this gives us again a value for λ , which will be different than in the case of fixed wages as there is no demand by uninformed traders.
- ▶ The trading profits of investment banks are all only generated by the fraction of traders that are informed.
- Using these trading profits, we can now investigate the profits of the investment bank, taking into account the remuneration they need to pay traders.

Investment bank profits

- ▶ Performance needs to be evaluated, this costs investment banks C
- ▶ Investment banks obtain trading profits, pay the wages to informed traders only, and face costs of evaluating trader performance
- ▶ Profits: $\hat{\Pi}_B = E[\Pi] - \gamma w - C$
- ▶ Investment banks will only operate a trading desk if $\hat{\Pi}_B \geq 0$
- ▶ This requires $\sigma_U \sigma_V \geq \frac{2C}{\gamma f} \sqrt{(1 + \gamma f)(2(1 + f) - (1 + \gamma f))}$
- ▶ Only if the uncertainty is large enough can informed traders generate enough profits to cover the costs of monitoring

- We can now see how the profits of investment banks paying performance wages are determined.
- ▶
 - As traders are paid based on their performance, they need to be evaluated to prevent an exaggeration of stated profits.
 - We assume that this evaluation of the traders' performance imposes fixed costs onto the investment bank.
- ▶
 - The investment bank obtains their expected trading profits,
 - from which they pay the remuneration to only informed traders. Uninformed traders will not trade and therefore generate no profits, obtaining no remuneration. The wage will be identical to what the trader would have obtained as an independent trader as in the case of fixed wages. What is different here is that this wage will not be the expected profits the independent trader makes, but the profits he would actually have realised.
 - Finally the investment bank has to cover the costs to evaluate the performance of its traders.
- ▶ In this case a trading desk will only be set up if it is profitable for the investment bank to do so.
- ▶ Inserting for all variables, gives the condition in the *formula*
- ▶ There are two sources of uncertainty in this model, the demand by noise traders (σ_U) and the uncertainty on the change of the asset value (σ_B). Only if both uncertainties are sufficiently large, can informed traders generate sufficient profits to cover the costs of evaluating their performance.
- Sufficient uncertainty is required to ensure that the informational advantage of informed traders is sufficient for them to be able to generate the requisite profits. If noise trading is very low, the price will adjust a lot given their trading demand and will thereby reveal most information they hold, reducing their informational advantage. If the uncertainty about the change of the asset value is low, the informational advantage an informed trader has in the first place is small and he will not be able to generate sufficient profits.

■ Problem and model assumptions

■ Independent traders

■ Fixed wages

■ Performance wages

■ **Optimal trader remuneration**

■ Summary

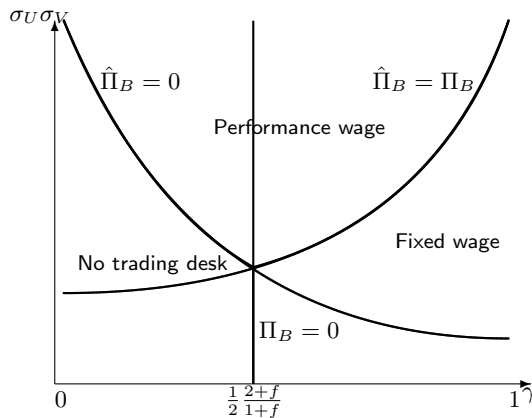
- We can now compare the profits investment banks make from paying fixed or performance-related wages.

Performance and fixed wages

- ▶ If a trading desk is operated, the bank needs to decide how to pay traders
- ▶ They will prefer paying a performance wage if $\hat{\Pi}_B \geq \Pi_B$
- ▶ This gives $\sigma_U \sigma_V \geq \frac{C}{\frac{\gamma f}{2} \frac{1}{\sqrt{(1+\gamma f)(2(1+f)-(1+\gamma f))}} - \frac{\gamma - \frac{1}{2} \frac{2+f}{1+f}}{\sqrt{2 \frac{1+\gamma f}{1+f} - \left(\frac{1+\gamma f}{1+f}\right)^2 - (1-\gamma)^2}}}$
- ▶ If many informed traders are present, the costs of fixed wages are low as few uninformed traders are rewarded, making fixed wages more attractive
- ▶ If the uncertainty is high, uninformed traders will make more losses, making the performance wage more attractive as then they do not trade and incur no losses

- As informed traders on fixed and performance wages obtain the same expected payment, equal to that of being independent, they are indifferent between the ways they can be paid. We will therefore focus on what form of wages is optimal for the investment bank.
- ▶ If we assume that it is profitable to operate a trading desk with fixed wages as well as performance-related wages, the investment bank needs to decide which form of remuneration they offer.
- ▶ A performance wage will be paid if this generates higher profits to the investment bank than paying a fixed wage.
- ▶ Inserting the profits for both remuneration forms, this condition can be solved for the *formula*.
- ▶
 - We see from this equation that with most traders being informed, fixed wages are preferred as the costs to the investment bank are lower.
 - The investment bank has to pay only few uninformed traders, who reduce profits further by trading at a loss.
 - These small losses are less than the costs of evaluating the performance of all informed traders when paying performance wages. Thus fixed wages are chosen.
- ▶
 - If the uncertainty in the market is high, the adverse selection is high and uninformed traders will make large losses.
 - These losses will outweigh the costs of evaluating the performance of traders;
 - in addition, uninformed traders do not trade with performance wages, reducing trading losses. This makes performance wages more attractive.
- We thus see that performance wages are preferred if the uncertainty in a market is high and the identification of competent (informed) traders is difficult for investment banks.

Equilibrium remuneration contracts for traders



- We can now graphically illustrate the optimal choice of contract type.
- ▶ We look at the uncertainty and the ability of investment banks to identify competent traders.
- ▶ We had firstly see that a fixed wage will not always be profitable.
- ▶ If the ability of investment banks to identify competent traders is sufficiently low, no trading desk with fixed wages will operate.
- ▶ If the ability of investment banks to identify competent traders is sufficiently high, a trading desk with fixed wages will operate.
- ▶ Similarly, we identified that trading desks with performance fees are not always profitable.
- ▶ Only if the uncertainty and ability of investment banks to identify competent traders are both sufficiently high, will a trading desk be profitable.
- ▶ This leaves the absence of a trading desk, regardless of the form of remuneration in cases where the investment banks struggle to identify competent traders and the market uncertainty is not sufficiently high.
- ▶ We then compared the decision whether the investment bank were to pay a performance wage or a fixed wage.
- ▶ We identified that performance wages were paid in cases where the uncertainty in the market is sufficiently high and the identification of competent traders is not too perfect.
- Depending on market characteristics (uncertainty) and the ability of investment banks to select traders (fraction of informed or competent traders), different remuneration forms for traders are chosen, if a trading desk is operated at all.

Impact of informed traders and uncertainty

- ▶ For few informed traders, the losses from employing uninformed traders are too high to allow a fixed wage
- ▶ For few informed traders, the profits from employing informed traders are too low to cover monitoring costs in performance wages
- ▶ For low uncertainty, the profits made by informed traders are too low to cover the evaluation costs in performance wages
- ▶ For many informed traders, the costs of paying uninformed traders is low compared to monitoring costs, making fixed wages more profitable

Impact of informed traders and uncertainty

- We can now repeat the main results of this model.
- ▶ If there are only few competent (informed) traders employed by the investment bank, the large fraction of less able (uninformed) traders causing trading losses will not allow a fixed wage to be paid as the less able (uninformed traders) are trading.
- ▶ If there are only few competent (informed) traders employed by the investment bank, the profits these generate are not sufficient to cover the evaluation costs of performance wages, even though less able (uninformed) traders do not trade and hence do not cause losses to the investment bank.
- ▶ If the uncertainty in the market is low, competent (informed) traders cannot make sufficient profits to cover the evaluation costs of performance wages, making fixed wages more attractive to the investment bank, despite the losses that uninformed traders will cause; these losses will be low, however, as the adverse selection will be low in such markets.
- ▶ If there are many competent (informed) traders employed by the investment bank, the costs of paying less able (uninformed) uninformed traders and their trading losses are low compared to the evaluation costs, inducing investment banks to choose fixed wages.
- We thus see that whether trading desk is profitable and how traders are remunerated will depend in the level of uncertainty in the market and the ability of investment banks to identify traders that will generate them profits.

■ Problem and model assumptions

■ Independent traders

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■ Optimal trader remuneration

■ Summary

- We can now summarize the key results and point out some implications of the findings.

Dominance of remuneration forms

- ▶ Investment banks will operate trading desks only if there is sufficient uncertainty in the market and they can employ enough informed traders
- ▶ Markets with lower uncertainty and easily identified informed traders will see fixed wages being paid, but the threshold is very high
- ▶ Highly volatile markets with fewer informed traders will see performance wages dominate
- ▶ We will mainly observe performance wages or no trading desk

- In practice we see that traders in investment banks are mainly paid through bonuses based on their trading performance; the model here backs this result.
- ▶ In general, investment banks will only operate a trading desk in market where there is sufficient uncertainty and they can identify traders that can trade profitably. Thus We should expect to see many investment banks operating trading desks in markets which are less transparent and less well understood by non-professional traders, provided the investment banks are reliably able to identify traders with a high ability to exert profits from other traders.
- ▶
 - If the market uncertainty is low, thus the market is generally well understood by most traders, a trading desk with fixed wages can be profitable, provide the investment bank is very good at identifying competent traders.
 - In realistic parameter constellations, the threshold for the identification of competent traders is very high and allows investment bank very few wrong decisions, making this scenario quite unlikely.
- ▶ Most markets, and especially those with high uncertainty, often seen in markets with high volatilities of asset prices, will see performance wages be paid, unless the investment banks can identify competent traders extremely reliably.
- ▶ Thus in most realistic cases we will see trading desks paying performance fees, or investment banks are not operating a trading desk at all; the existence of trading desks with fixed wages is unlikely.
- We therefore see that our model obtains a dominance of trading desks with performance wages, where trading desks can be found in markets that are not too well understood. This replicated well actual observations of which assets are traded by investment banks.

Markets with trading desks

- ▶ Trading in well-understood securities will be less attractive to investment banks
- ▶ If traders can be identified as understanding a market sufficiently well, they will be paid performance wages
- ▶ This should be reflected in the importance of bonus payments in the total remuneration of traders

- We can now emphasize the types of markets that will see proprietary trading by investment banks.
- ▶ Well understood securities are not attractive to investment banks, who seek to trade in markets that are less certain to less able (uninformed) investors. They might also reduce their trading activity during times in which markets are 'quiet', that is show little uncertainty, and then increase trading activity once market conditions change.
- ▶ If investment banks are able to identify competent traders sufficiently well through their recruitment process, they will normally be paid performance wages to avoid payment to those traders that have been mis-identified.
- ▶ We should thus overall see traders being rewarded mainly through bonus payments based on their performance, with only a small fixed wage.
- Investment banks only engage in proprietary trading in markets that are showing a sufficient degree of uncertainty to uninformed traders and it is optimal for them to base the remuneration of traders on their trading performance.



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