

**Q1** The expected profit to Leban if Galoot takes the necessary control actions is \$3,500 while if Galoot is not hired, the expected profit is \$500. As the additional expected profit is greater than \$2,400, Galoot's compensation Leban should hire Galoot. Galoot will of course be paid only if he is observed to be taking the necessary actions.

**Q2** The salary contract can be based only on observable outcomes, in this case only on the final observed profit. Suppose Leban pays to Galoot \$W if profit of \$5,000 is produced and \$X if profit of (\$1,000) is produced. Let \$W and \$X be the additional bonus or penalty over and above Galoot's regular pay of \$40,000. If Galoot takes the necessary effort, the probability of producing profit is 0.75 but he loses the opportunity cost of taking the effort having accepted the job. On the other hand, not taking the necessary effort is costless to Galoot but the probability of producing profit is only 0.25. Galoot's

$$\begin{aligned} \text{Expected additional wealth (if take effort)} &= 0.75 \times \$W + 0.25 \times \$X \\ \text{Expected additional wealth (if take No effort)} &= 0.25 \times \$W + 0.75 \times \$X + \$800 \end{aligned}$$

If Galoot is to accept the contract [\$W, \$X] and take the effort -

- 1  $0.75 \times \$W + 0.25 \times \$X > 2,400$  as he should receive a positive expected wealth
- 2  $0.75 \times \$W + 0.25 \times \$X > 0.25 \times \$W + 0.75 \times \$X + \$800$  as he should be motivated to take the necessary effort.

This last inequality (2) can be rewritten

- 2a  $0.5 [ \$W - \$X ] > 800$  as
- 3  $\$W - \$X > 1,600$

$$\begin{aligned} \text{Solving 1 and 3 as equalities we get} \quad \$W &= \$2,800 \\ &\$X = \$1,200 \end{aligned}$$

This contract [ \$2,800, \$1,200 ] will induce Galoot to accept the contract and take the necessary effort. The expected salary if he takes the necessary effort is \$2,400 and Leban's cost is also \$2,400 i.e.

$$0.75 \times 2,800 + 0.25 \times 1,200 = 2,400$$

Note this is also the cost to Leban of motivating Galoot to take the necessary effort even when Leban was able to observe Galoot's actions (as in question a). So unobservability of effort does not cost Leban as long as Galoot is risk neutral.

Leban can also sell the Riasy operation to Galoot for \$1,100. If the profit from the Riasy project turns out be (\$1,000) then Galoot ends up with (\$2,100) and if the profit turns out be \$5000 then Galoot ends up with \$3,900. The net amount to Galoot if he works is the same as in the old contract, i.e.,

$$0.75 \times \$3,900 + 0.25 \times [-\$2,100] = 2,400$$

Of course "selling" the project is highly motivating. The managers will work very hard as every penny their effort generates is theirs. But this will be the preferred solution only if the managers are completely risk neutral and have deep pockets.

**Q3** The salary contract can be based only on observable outcomes, in this case only on the final observed profit. Instead of solving for the dollar salaries to be paid, we will work with utilities to be paid. Suppose Leban pays to Galoot  $w$  utility units if profit of \$5,000 is produced and  $x$  utility units if profit of (\$1,000) is produced. Let  $w$  and  $x$  be the additional bonus or penalty utility units over and above Galoot's regular utility units of 40,000 derived from regular pay. If Galoot takes the necessary effort, the probability of producing profit is 0.75 but the cost of effort to Galoot is 2,400 utility units. On the other hand, not taking the necessary effort is costless to Galoot but the probability of producing profit is only 0.25. Galoot's

$$\begin{aligned} \text{Expected additional utility(if take effort)} &= 0.75 w + 0.25 x \\ \text{Expected additional utility(if take No effort)} &= 0.25 w + 0.75 x + 800 \end{aligned}$$

If Galoot is to accept the contract  $[w, x]$  and take the effort

- 1  $0.75 w + 0.25 x > 2,400$  as should be paid a positive expected wealth
- 2  $0.75 w + 0.25 x > 0.25 w + 0.75 x + 800$  as he should be motivated to take the necessary effort.

This last inequality (2) can be rewritten as

- 3  $0.5 [w-x] > 800$
- $w-x > 1,600$

Solving 1 and 3 as equalities we get  $w = 2,800$ ;  $x = 1,200$

Until here the solution is identical to the solution to (b) except that we deal in utility units and not in dollar amounts)

To give 3,000 utility units to Galoot Leban has to pay  
 $\$2,400 + [2,800 - 2,400]/0.8 = \$ 2,900$

To give 1,200 Utility units to Galoot Leban has to pay \$1,200.

This contract (\$2,900, \$800 ) will induce Galoot to accept the contract and take the necessary effort. The expected utility if he takes the necessary effort is 2,400 but Leban's expected cost is  $0.75 \times \$2,900 + 0.25 \times \$1,200 = \$2,475$ . Note this is \$75 (also obtained from  $0.75 [\text{probability}] \times \$400 [\text{extra utility units over 2,800}] \times 0.25 [\text{utility premium}]$  ) more than the cost to Leban of motivating Galoot to take the necessary effort in part (b). So unobservability of effort and Galoot's risk aversion costs Leban \$75. This \$75 is usually referred as agency costs.