The contracts of at least 33 major league baseball players have incentive clauses providing a bonus if that player is named Most Valuable Player in a Division Series. Unfortunately, no such award is given for a Division Series.
Chapter 19 Outline

19.1 Principal-Agent Problem
19.2 Production Efficiency
19.3 Trade-Off Between Efficiency in Production and in Risk Bearing
19.4 Payments Linked to Production or Profit
19.5 Monitoring
19.6 Contract Choice
19.1 Principal-Agent Problem

- The *principal*, such as an employer, contracts with the *agent*, such as an employee, to take some *action* that benefits the principal.

- If the principal cannot monitor an agent constantly, the agent may steal, shirk responsibilities, or engage in other opportunistic behavior that lowers productivity.
  - This is the *principal-agent problem*.
  - Example: You pay someone by the hour to prepare your tax return, but don’t know whether he/she worked all the hours that were billed.
19.1 Types of Contracts

- Three common types of contracts:

  1. **Fixed-fee contracts**
     - Payment to the agent is independent of the agent’s actions, the state of nature, or the outcome.
     - Principal keeps the residual profit

  2. **Hire contracts**
     - Payment to the agent depends on the agent’s actions as they are observed by principal.
     - Types include *hourly rate* and *piece rate*.

  3. **Contingent contracts**
     - Payments to principal and agent depend on state of nature, which may be unknown when contract is written.
     - In a *sharing contract*, payoffs to each person are a fraction of total profit.
19.1 Efficiency

- Type of contract used depends on what the parties observe.
  - Hire contract used if principal can easily monitor agent’s actions.
  - Contingent contract used if state of nature observed after work is completed.
  - Fixed-fee contract has no observation requirements.

- An **efficient contract** has provisions that ensure no party can be made better off without harming the other party.
  - Results in **efficiency in production**, where combined payoffs are maximized.
  - Results in **efficiency in risk bearing**, where person who least minds risk bears more of the risk.
19.2 Production Efficiency

• The type of contract that an agent and principal use affects production efficiency.

• To be efficient and maximize the joint profit of the agent and principal, a contract needs two properties:
  1. Contract must provide large enough payoff that agent is willing to participate in the contract.
  2. Contract must be *incentive compatible* in that it makes the agent want to perform assigned tasks rather than engage in opportunistic behavior.
19.2 Production Efficiency Example

- Buy-A-Duck store sells wooden duck carvings
  - Paula is the principal (owner) and Arthur is the agent (manager)
  - Joint profit is a function of the number of ducks sold \( a \), which is determined by Arthur’s actions and the marginal cost of producing one more carving, \( m \):

\[
\pi(a) = R(a) - ma
\]

- How many ducks must Arthur sell to maximize joint profit?
  - FOC:

\[
\frac{d\pi(a)}{da} = \frac{dR(a)}{da} - m = 0
\]

- We can analyze this graphically with a few assumptions.
19.2 Production Efficiency Example

- Assuming $m = 12$ and inverse demand is $p = 24 - \frac{1}{2} a$, Arthur maximizes his profit and joint profit at $a = 12$. 
19.2 Full Information: Fixed-Fee Contract

- Assume both Paula and Arthur have full information about Arthur’s actions and the effect on profit.

- In this situation, are there incentive-compatible fixed-fee contracts that do not require monitoring and supervision?
  - Arthur earns a residual profit; profit less fixed rent he pays Paula.
  - FOC is unchanged, so profit is still maximized when Arthur sells 12 ducks.
  - This occurs because Arthur gets entire marginal profit from selling one more duck.
19.2 Full Information: Hire Contract

• Now suppose Paula contracts to pay Arthur for each duck he sells (a hire contract).
  • If she pays him $12 per duck, Arthur just breaks even on each sale because $m = 12$.
  • Even if he agrees to this contract, he requires supervision because he gets no marginal profit from selling one more duck.
• Paula must offer Arthur more than $m$ per duck for him to have incentive to sell as many as he can.
  • Such a contract is not incentive compatible.
  • Joint profit maximization requires $MR = MC$, and Paula’s offer $>m$ means she directs Arthur to sell fewer ducks than is optimal.
19.2 Full Information: Contingent Contract

- Now suppose Paula and Arthur use a contingent contract to share the revenue.
  - Arthur receives $\frac{3}{4} R$; Paula receives $\frac{1}{4} R$.

- Under this revenue-sharing contract, Arthur’s $MR$ curve is below $MR$ in a different type of contract.
  - For example, selling 12 ducks no longer brings in $12$ in additional revenue; 12 ducks brings in $\frac{3}{4} \times 12 = 9$ in $MR$.

- Thus, joint profit is not maximized when the agent maximizes his own profit in this type of contract.
19.2 Full Information: Revenue Sharing
19.2 Full Information: Contingent Contract

• Now suppose Paula and Arthur use a **contingent contract** to share the profit.
  • Arthur receives one-third of the joint profit.

• Under this profit-sharing contract, Arthur only earns one-third of the profit, but also only bears one-third of the $MC$.

• Joint profit is maximized when the agent maximizes his own profit; profit-sharing is efficient.
19.2 Full Information: Profit Sharing

The diagram illustrates the relationship between the agent's profit, $\pi$, and the number of duck carvings per day, $a$.

- The orange curve represents the joint profit, $\pi$, which peaks at 72 when $a = 12$.
- The purple curve represents the agent's profit, $\frac{1}{3}\pi$, which peaks at 24 when $a = 12$.

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19.2 Asymmetric Information

- Now assume that the principal, Paula, has less information than the agent, Arthur.
  - She can’t observe the number of ducks he sells or the revenue.

- What occurs under the four different contract types?
  - **Fixed-fee contract** yields joint-profit-maximizing quantity.
  - **Hire contract** results in less-than-optimal quantity if Arthur is honest and greater-than-optimal quantity if he is not.
  - **Revenue-sharing contract** is still inefficient.
  - **Profit-sharing contract** is efficient if he reports revenue and cost to Paula honestly.
## 19.2 Production Efficiency

**Summary**

- With asymmetric information, only fixed-fee contract is efficient and has no moral hazard problem.

<table>
<thead>
<tr>
<th>Contract</th>
<th>Full Information</th>
<th>Asymmetric Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production</td>
<td>Production</td>
</tr>
<tr>
<td></td>
<td>Efficiency</td>
<td>Efficiency</td>
</tr>
<tr>
<td>Fixed-fee rental contract</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rent (to principal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hire contract, per unit pay</td>
<td>No(^a)</td>
<td>No(^b)</td>
</tr>
<tr>
<td>Pay equals marginal cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay is greater than marginal cost</td>
<td>No(^c)</td>
<td>No</td>
</tr>
<tr>
<td>Contingent contract</td>
<td>No</td>
<td>No(^b)</td>
</tr>
<tr>
<td>Share revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share profit</td>
<td>Yes</td>
<td>No(^b)</td>
</tr>
</tbody>
</table>

\(^a\)The agent may not participate and has no incentive to sell the optimal number of carvings. Efficiency can be achieved only if the principal supervises.

\(^b\)Unless the agent steals all the revenue (or profit) from an extra sale, inefficiency results.

\(^c\)The agent sells too many or the principal directs the agent to sell too few carvings.
19.3 Trade-Off Between Efficiency in Production and in Risk Bearing

• Usually, a contract does not achieve efficiency in production and in risk bearing.
  • There exist trade-offs between these two objectives.

• Example: Contracting with a lawyer
  • Pam is the principal who has been injured in a traffic accident.
  • Alfredo is the agent and is her lawyer.
  • Pam faces uncertainty due to risk and asymmetric information.
  • Trial outcome depends on Alfredo’s hours of effort, $a$, and attitudes of the jury (state of nature, $\theta$).
  • Pam never learns $\theta$, so if she loses the case, she doesn’t know if it was because Alfredo didn’t work hard enough.
19.3 Trade-Off Between Efficiency in Production and in Risk Bearing

- The choice of various possible contracts between Pam and Alfredo affects whether they achieve efficiency in production or in risk bearing.

<table>
<thead>
<tr>
<th>Type of Contract</th>
<th>Fixed Fee to Lawyer</th>
<th>Fixed Payment to Client</th>
<th>Lawyer Paid by the Hour</th>
<th>Contingent Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawyer’s payoff</td>
<td>$F$</td>
<td>$\pi(a, \theta) - F$</td>
<td>$wa$</td>
<td>$\alpha \pi(a, \theta)$</td>
</tr>
<tr>
<td>Client’s payoff</td>
<td>$\pi(a, \theta) - F$</td>
<td>$F$</td>
<td>$\pi(a, \theta) - wa$</td>
<td>$(1 - \alpha)\pi(a, \theta)$</td>
</tr>
<tr>
<td>Production efficiency?</td>
<td>No*</td>
<td>Yes</td>
<td>No*</td>
<td>No*</td>
</tr>
<tr>
<td>Who bears risk?</td>
<td>Client</td>
<td>Lawyer</td>
<td>Client</td>
<td>Shared</td>
</tr>
</tbody>
</table>

*Production efficiency is possible if the client can monitor and enforce optimal effort by the lawyer.*
19.4 Payments Linked to Production or Profit

• How might additional clauses be added to a contract to eliminate or reduce moral hazards?

• An employer might get employees to work hard by paying by the output they produce.
  • *Piece-rate* hire contracts explicitly reward productivity and thereby provide greater incentive to work hard than hourly wages.

• Workers with harder-to-quantify productivity may be rewarded with year-end bonuses based on increases in firm profit or stock value.
19.5 Monitoring

• When a firm can’t use piece rates or rewards, they usually pay fixed-fee salaries or hourly wages.
  • These methods may encourage shirking and/or inflating work hours.
  • Firm can reduce shirking through increased monitoring.

• Monitoring eliminates the asymmetric information problem because both the employer and the employee know how hard the employee works.
19.5 Monitoring

- Types of monitoring:
  - Requiring punching a time clock
  - Installing surveillance cameras
  - Installing assembly lines (sets work pace)
  - Recording employees’ voicemail, email, phone calls
  - Reviewing employees’ computer files

- Monitoring is most common in the financial sector, in which 81% of firms use the above techniques.

- Monitoring may lower morale and, in turn, productivity.
19.5 Monitoring

• A direct approach to ensuring good behavior by agents is to require they deposit funds guaranteeing good behavior.
  • A performance bond is an amount of money that will be given to the principal if the agent doesn’t complete assigned duties or achieve specific goals.

• Suppose worker’s value on gain from shirking is $G$ and the worker must post a bond of $B$, which is forfeited if he is caught shirking.
  • If $\theta$ is the probability of being caught shirking, a risk-neutral worker won’t shirk if $G \leq \theta B$ (gain $\leq$ expected penalty).
19.5 Monitoring

- The minimum bond that discourages shirking is
  \[ B = \frac{G}{\theta} \]
  - Bond must be larger the higher the value the employee places on shirking and the lower the probability of being caught.

- Employers like bonds because it reduces monitoring necessary to discourage moral hazards.
  - More commonly used to deter theft than shirking.
  - Workers may not have enough money to post a bond.
19.5 Monitoring

- Firms discourage shirking by raising an employee’s cost of losing a job.

- An alternative is for the firm to pay an unusually high wage, called an **efficiency wage**.
  - If the going wage is $w$, an efficiency wage is $w > w$.

- The extra earnings, $w - w$, serves the same function as the bond, $B$, in discouraging bad employee behavior.

\[
    w - w = \frac{G}{\theta}
\]
19.6 Contract Choice

• A firm may choose to concentrate on hiring industrious workers rather than on stopping lazy workers from shirking.
  • Such a firm seeks to avoid moral hazard problems by preventing adverse selection.

• Firms may be able to determine which prospective workers will work hard by giving them a contract choice.
  • Those who select contingent contracts, in which pay depends on how hard they work, signal they are hard workers.
  • Those who choose fixed-fee contracts signal they are lazy workers.
### 19.6 Contract Choice

- Workers sort themselves when the firm offers two different contracts.

<table>
<thead>
<tr>
<th></th>
<th>Contingent Contract (30% of Sales), $</th>
<th>Fixed-Fee Contract ($25,000 Salary), $</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hard Worker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>100,000</td>
<td>100,000</td>
</tr>
<tr>
<td>- Salesperson’s pay</td>
<td>-30,000</td>
<td>-25,000</td>
</tr>
<tr>
<td>= Firm’s net revenue</td>
<td>70,000</td>
<td>75,000</td>
</tr>
<tr>
<td>- Office expenses</td>
<td>-50,000</td>
<td>-50,000</td>
</tr>
<tr>
<td>= Firm’s profit</td>
<td>20,000</td>
<td>25,000</td>
</tr>
<tr>
<td><strong>Lazy Worker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td>- Salesperson’s pay</td>
<td>-18,000</td>
<td>-25,000</td>
</tr>
<tr>
<td>= Firm’s net revenue</td>
<td>42,000</td>
<td>35,000</td>
</tr>
<tr>
<td>- Office expenses</td>
<td>-50,000</td>
<td>-50,000</td>
</tr>
<tr>
<td>= Firm’s profit</td>
<td>-8,000</td>
<td>-15,000</td>
</tr>
</tbody>
</table>