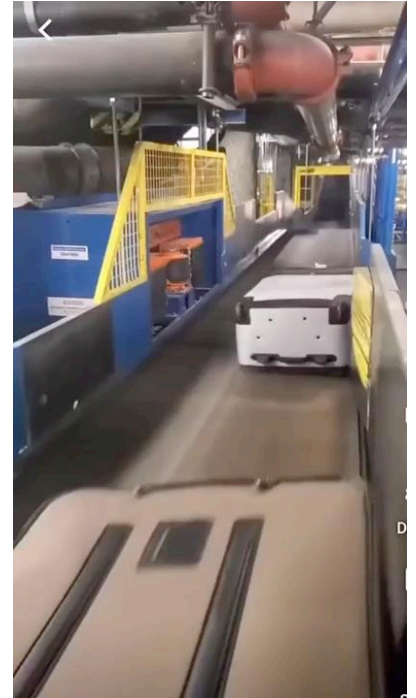


Moral Hazard



Moral Hazard



From an economics and strategy perspective, what are the main difference between these two scenarios?

Moral Hazard in the Workplace

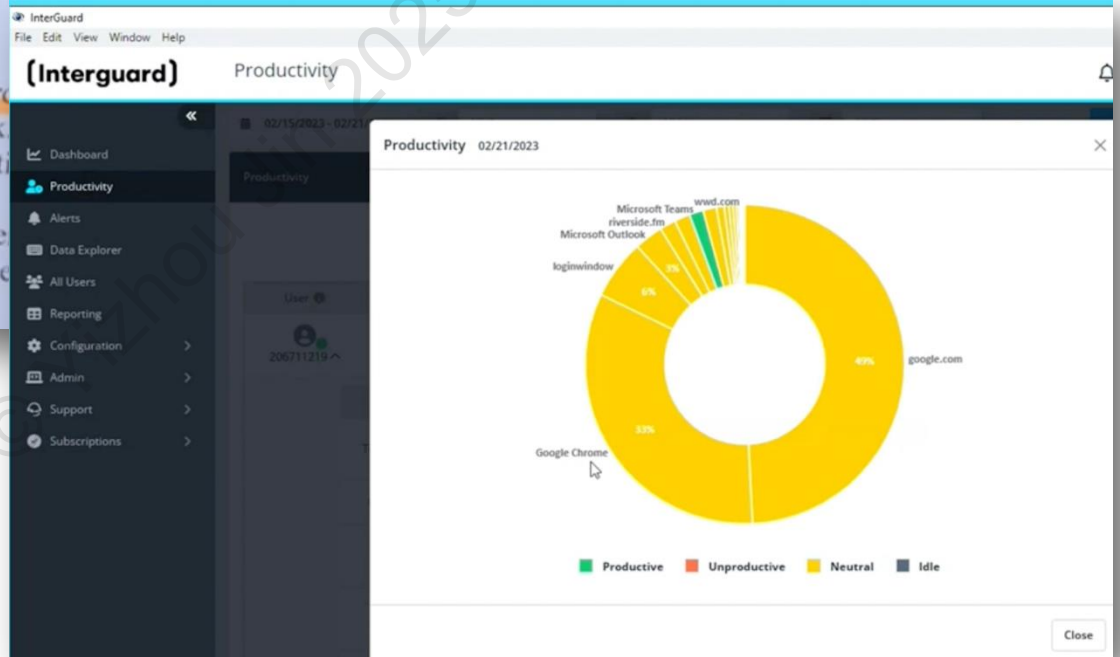


Moral Hazard in the Workplace

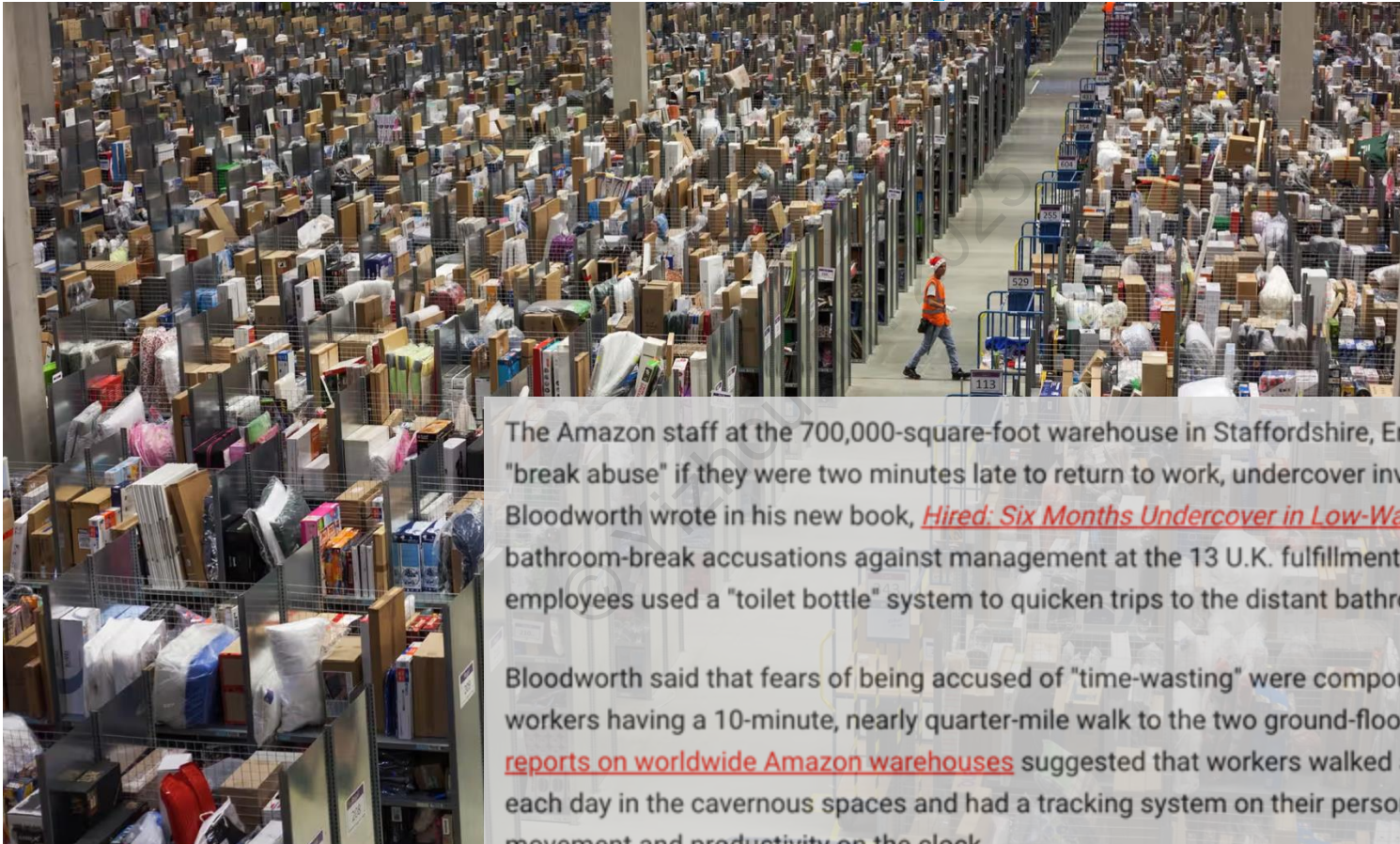
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Moral Hazard in the Workplace



The Amazon staff at the 700,000-square-foot warehouse in Staffordshire, England, was accused of "break abuse" if they were two minutes late to return to work, undercover investigator James Bloodworth wrote in his new book, *Hired: Six Months Undercover in Low-Wage Britain*. The bathroom-break accusations against management at the 13 U.K. fulfillment centers detailed how employees used a "toilet bottle" system to quicken trips to the distant bathrooms.

Bloodworth said that fears of being accused of "time-wasting" were compounded by the 1,200 workers having a 10-minute, nearly quarter-mile walk to the two ground-floor toilets. [Previous reports on worldwide Amazon warehouses](#) suggested that workers walked an average of 10 miles each day in the cavernous spaces and had a tracking system on their person that followed their movement and productivity on the clock.

Holmström (1979)

- Let's say that there's a principal P , and an agent A
- Now P wants A to do some action a on P 's behalf, in order to achieve some outcome q
 - What's P, A, q, a in the luggage handler context?
 - What's P, A, q, a in the Amazon employee bathroom break case?
- P thus needs to sign a contract with A
- Our goal is to understand what is the best contract for P when...
 1. P observes both q and a (e.g. $q = a$)
 2. P observes q but not a (e.g. $q = a + \text{some risk}$)
 1. What if P and A are both risk neutral?
 2. What if P is risk neutral but A is risk averse?

The information problem---**a being not observed**---is a direct result of **risk!**

Principal Agent Problem

Case 1: P Observes Outcome and A's Action (e.g. $q = a$)

Contract: P pays wage w^* when the agent does a^*

$w = w^*$ if and only if $q = a^*$

Principal (P): (4) Hence, P can dictate that it wants a particular action a^* , and will only compensate A (with a fixed salary w^*) if it receives $q = a^*$.

Self-interested in profit : outcome minus wage

$$\pi = q - w$$

(1) P is the bearer /

recipient of the outcome:

e.g. employer gets the profit of a project; insurers bear the cost of insurance claims

P observes A's action a .
 Key problem for P: what's the best a^* and w^* ?

Agent (A):

Self-interested in payoff: wage minus action cost

$$H = w - c(a)$$

assume outside option is 0

(2) A is the action taker that influence the outcome: e.g. employee works hard;

insured drivers drive safely

A chooses action a to realize outcome $q = a$

(3) action always influences outcome, but in this case, it does so deterministically so that given q , a is perfectly inferred

Principal Agent Problem

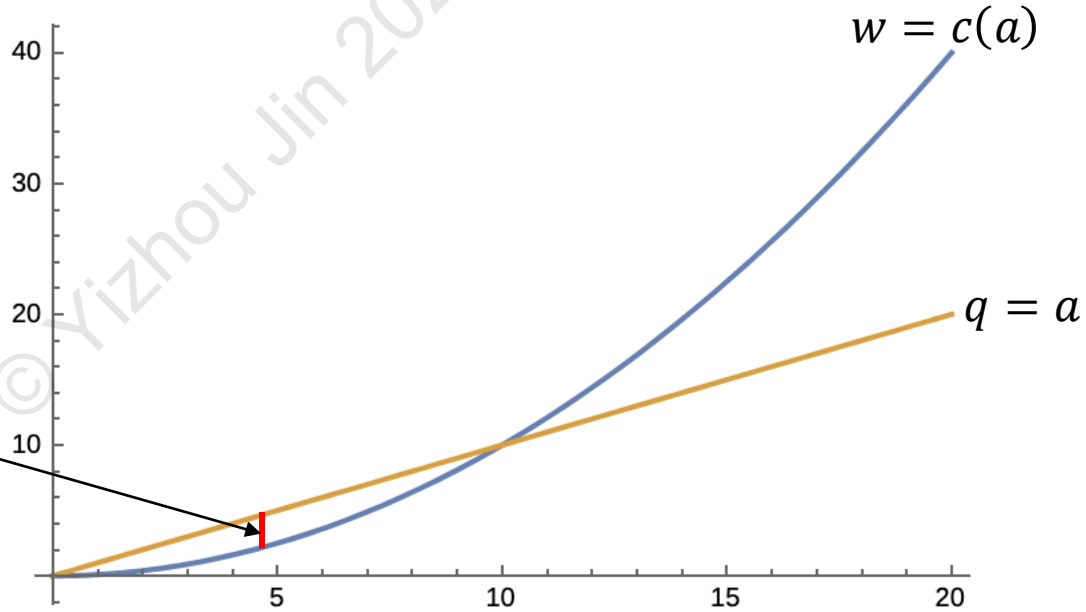
Case 1: P Observes Outcome and A's Action (e.g. $q = a$)

We call this "Participation Constraint" for P (when determining $w = \alpha$ and a^*) as in P must respect A's outside option

- In order to induce A to do some action a , how much should P pay A?
 - A's outside option is 0, so A accepts the contract as long as $H = w^* - c(a) \geq 0$, which means that P needs pay at least $w^* = c(a)$ (on or above the blue line)


- P maximizes profit by choosing best a^* and paying the corresponding $w^* = c(a^*)$.
 - Paying more reduces profit without changing a or q
 - Let's assume that $c(a) = \frac{a^2}{10}$ (exerting effort becomes increasingly costly)
 - Profit $\pi = a - w^* = a - c(a)$ is maximized when $a^* = 5$
 $\rightarrow w^* = c(a^*) = 2.5$

setting $\frac{\partial \pi(a^*)}{\partial a^*} = 0$
 (difference between yellow and blue lines)



Principal Agent Problem

Case 2: P Observes Outcome but not A's Action (e.g. $q = a + \epsilon$)

P sets a "linear contract": $w(q) = w^* + b^* \times q$  w^* is a fixed salary and b^* is performance bonus

Principal (P):

Self-interested in profit : outcome minus wage

$$\pi = q - w(q)$$

P does not see A's action a but wish to incentive higher a by rewarding higher q .


Key problem for P:
what's the best w^* and b^*

Agent (A):

Self-interested in payoff: wage minus action cost
 $H = w(q) - c(a)$

assume outside option is 0


A chooses action a to realize outcome $q = a + \epsilon$ 

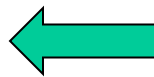
$\epsilon \sim N(0, \sigma^2)$ is a mean-zero stochastic noise so that outcome q is positively influenced by a but one cannot know a based on q alone. 

Principal Agent Problem


Case 2: P Observes Outcome but not A's Action (e.g. $q = a + \epsilon$)

- q, π, H are now uncertain: must use expectation
 - Remember, q is no longer observable because of risk!
 - Assume for now that both P and A are risk neutral (not risk averse)
 - For a given contract $\{w = w^* + b^*q\}$, $H = E[w - c(a)] = w^* + b^* \cdot a - \frac{a^2}{10}$

- We know that $b^* > 0$  *Such a simple/important insight!*
 - If $b^* = 0$ (no performance bonus), A will optimally set $a = 0$

- A chooses a to maximize H: $\frac{\partial H(a^*)}{\partial a^*} = 0 \rightarrow a^*(b^*) = 5b^*$ 

We call this "[A's] Incentive Constraint" for P as in P must incentivize A to increase a by setting $b^* > 0$ now that a is no longer observed by P

- P chooses w^* and b^* to maximize $\pi = E[q - w(q)] = (1 - b^*) \cdot a^*(b^*) - w^*$
 - $b^* = 0.5$
 - $w^* = -0.625$ (by setting $H = 0$)  *We call this "[A's] Participation Constraint" for P as in P must respect A's outside option*

Taking Stock

- Moral hazard is like a tax (of magnitude b^*) on P 's profit
 - Without moral hazard, the expected output is 5 since $a^* = 5$
 - With moral hazard, the expected output is 2.5 since $a^* = 5b^*$ and $b^* = 0.5$
- Imperfect information (cannot observe agent actions), caused by the introduction of risk, leads to moral hazard. The prevention of which imposes significant cost on overall economic activities and gives rise to profit-sharing and performance-based contracts.

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Holmström (1979)

What if A is risk aversion?

Risk aversion measures how much you dislike (are willing to pay to remove) uncertainty

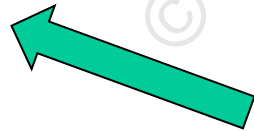
- Say you can either
 1. Receive \$10 now
 2. Flip a coin to get \$0 or \$20
- If you prefer 1, you are risk averse
- If you are indifferent between 1 and 2, you are risk neutral
- Risk aversion is typically represented by concave utility functions

- A is typically risk averse and P much less so
 - e.g. employee – firm; insuree – insurer

Holmström (1979)

- A chooses a to maximize $H = E[U(w - c(a))]$
 - $U(\cdot)$ is a concave utility function
 - Let r denote the risk aversion coefficient (denotes how “concave” $U(\cdot)$ is)
- P chooses w^* and b^* to maximize $\pi = E[q - w(q)] = (1 - b^*) \cdot a^*(b^*) - w^*$

$$- b^* = \frac{1}{1 + \frac{r\sigma^2}{5}}$$



No need to memorize formulas.

Key takeaway: The more risk aversion A is, or the more noisy/risky profit is, the less P should profit-share with A since A is risk averse.

Taking Stock

- Moral hazard is like a tax (of magnitude β) on P 's profit
 - Without moral hazard, the expected output is 5 since $a = 5$
 - With moral hazard, the expected output is 2.5 since $a = 5\beta$ and $\beta = 0.5$
 - Imperfect information on agent actions leads to moral hazard. Imperfect information on A 's actions leads to moral hazard. The prevention of which imposes significant cost on overall economic activities and gives rise to profit-sharing and performance-based contracts.
- Risk aversion
 - → Does not change the necessity of performance pay
 - However, since P is more capable of handling risk than A , any profit sharing also shares the risk of ϵ with A , which is inefficient.
 - P can thus more efficiently incentivize A by
 - Sharing less profit (lower b^*) and increasing base salary (higher w^*)
 - But b^* can still never be 0

Taking Stock

- All this insight is derived based on three simple conditions

Scenario	$q = a$	$q = a + \epsilon$
Contract structure	$w = w^*$ iff $q = a^*$	$w(q) = w^* + b^* \times q$
A IC (H maximization)	N/A	$\frac{\partial E[H(a^*)]}{\partial a^*} \stackrel{!}{=} 0$
P profit (π) maximization	$\frac{\partial \pi(a^*)}{\partial a^*} \stackrel{!}{=} 0$	$\frac{\partial E[\pi(a(b^*))]}{\partial b^*} \stackrel{!}{=} 0$
A PC (H better than outside option)	$H(w^*, a^*) \geq 0$	$E[H(w^*, b^*)] \geq 0$

Why All These Algebra?!

- Numerical models can be very elegant and precise
 - The setup is technically very simple! (a is action, $c(a)$ is cost of action, w if wage, alpha)
 - But the implications are very rich!
 - Make sure you understand the set up well (e.g. what did we assume is the outside option for A?)
- Models are meant to deepen your intuitive understanding
 - Don't memorize the formulas
 - Think about what each equation mean in the real world (e.g. suppose we have a linear contract $w = -1 + 0.5q$, what can this represent in the real world?)

Moral Hazard as an Asymmetric Information Problem (e.g. auto insurance)

Suppose drivers have fixed accident probabilities known to themselves but not to insurers

- When insurance companies do not know the probabilities, **adverse selection** may occur

Akerlof / Spence models

Solution: mandate / risk rating

Suppose drivers must all be incentivized to exert effort to act safely

- When insurance companies do not observe effort (and accidents are stochastic), **moral hazard** may occur

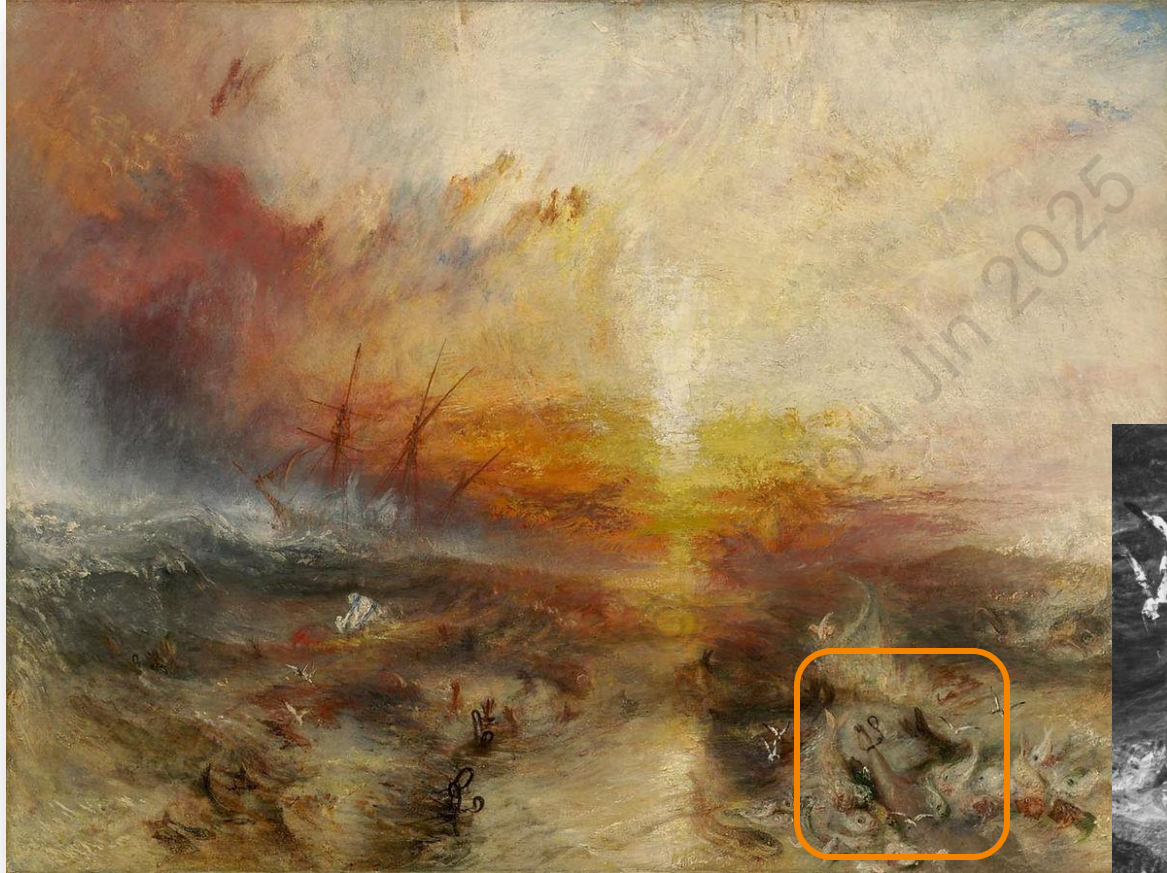
Holmström model

Solution: copay (linear contract) / monitoring

The truth is often a combination of both

- Maybe people can reduce their risk (via effort to drive safely) but only to a certain extent
- Maybe people do not exert effort to reduce their risk unless they are constantly reminded

Moral Hazard



Slave Ship

Joseph Mallord William Turner
1840

@ Boston MFA



[Turner] based the painting on an 18th-century poem that described a slave ship caught in a typhoon and on the true story of the Zong, a British ship whose captain, in 1781, had thrown overboard [132] sick and dying enslaved people so that he could collect insurance money only available for those "lost at sea."

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Alongside the painting, is William Turner's unfinished poem "Fallacies of Hope:"

Aloft all hands, strike the top-masts and belay;

Yon angry setting sun and fierce-edged clouds

Declare the Typhon's coming.

Before it sweep your decks, throw overboard

The dead and dying – ne'er heed their chains

Hope, Hope, fallacious Hope!

Where is thy market now?

Moral Hazard in Finance more generally

- Asymmetric information in credit card borrowing
 - Some do not have enough income to pay back [adverse selection]
 - Others may choose not to [moral hazard]
- Solution
 - Reputation (credit score) and due diligence prevent adverse selection by
 - providing more information on income/creditworthiness
 - Borrowing limits mitigates moral hazard by
 - effectively imposing dynamic punishment of default (“loss” sharing)
 - Monitoring mitigates moral hazard by
 - Bigger or long-term loans tend to require on-going monitoring