# Game theory II

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# Game theory

- Discrete games and the emergence of cooperation
- Hidden action and sharecropping
- Hidden information and the signalling model of education

# Roadmap

Introduction

Sharecropping

Multitasking

Evidence

# Risk: Set-up

Consider a simple decision problem under uncertainty: a consumer's decision whether or not to purchase insurance.

Consumer obtains utility from a consumption good, $x$: $u(x)$.

Suppose $x$ is a realization of a random variable $X$, where $X \sim (\mu, \sigma^2)$.

Consumer is offered an insurance contract:

- If she accepts, the insurance company absorbs all of the risk from $X$ and provides consumer with consumption $c$ (i.e., insurance absorbs both "upside" and "downside" risk).

Q: Should the consumer take the insurance product?

# Risk: Intuition

Answer depends on the guaranteed consumption that is being offered, i.e., $c$.

If $c$ is low enough, the consumer will choose not to take up the insurance.

If $c$ is high enough, the consumer will take up the insurance.

Q: How high does $c$ need to be?

# Risk: Certainty equivalence

Assume that $u(\cdot)$ is continuous, strictly increasing, and defined for all $x \in (\underline{x}, \bar{x})$.

Treat consumers as maximizing expected utility (VNM Utility Theorem).

The consumer will purchase the insurance product iff

$$u(c) \;\geq\; \int_{\underline{x}}^{\bar{x}} u(x) f(x)\, dx \;\equiv\; \mathbb{E}[u(x)].$$

Since $u(\cdot)$ is strictly increasing, we can define the certainty equivalent (CE), $\bar{c}$, and say that the consumer will purchase insurance iff $c \geq \bar{c}$, where

$$u(\bar{c}) = \mathbb{E}[u(x)] \;\Rightarrow\; \bar{c} = u^{-1}\big(\mathbb{E}[u(x)]\big).$$

# Risk: Certainty equivalence

If we know/assume $u$ and $f$, we can calculate CE.

Not always useful, since we may want to make general statements without making assumptions about $u$ and $f$.

However, useful in some cases! For example, when $u(\cdot)$ is linear in its argument, then $\bar{c} = \mu$.

Why? $u(\bar{c}) = \mathbb{E}[u(x)] \Rightarrow \bar{c} = \mathbb{E}[x] = \mu$.

# Risk: Risk Averse, Neutral, Loving

**Jensen's Inequality:** If $X$ is a random variable

- and $u$ a strictly convex function, then $\mathbb{E}[u(X)] > u(\mathbb{E}[X])$;
- and $u$ a strictly concave function, then $\mathbb{E}[u(X)] < u(\mathbb{E}[X])$.

Hence, if $u$ is strictly concave,

$$u(\mu) = u[\mathbb{E}(x)] > \mathbb{E}[u(x)] = u(\bar{c}) \quad \Rightarrow \quad \bar{c} < \mu.$$

Hence, if $u$ is strictly convex,

$$u(\mu) = u[\mathbb{E}(x)] < \mathbb{E}[u(x)] = u(\bar{c}) \quad \Rightarrow \quad \bar{c} > \mu.$$

This links the curvature of $u$ to the consumer's preference over risk!

# Risk: Risk Averse, Neutral, Loving

- **Risk averse:** $u$ is concave, i.e., the consumer would be willing to trade consumption in exchange for eliminating risk.
- **Risk loving:** $u$ is convex, i.e., the consumer would need to receive more consumption in exchange for eliminating risk.
- **Risk neutral:** $u$ is linear, i.e., the consumer is indifferent between whether or not to take insurance, when that insurance is offered for free.

# Risk: Risk Premium

Instead of making assumptions about $u$ and $f$, we can also approximate CE.

Define $p$ as the cost of insurance (the risk premium), such that

$$\bar{c} \equiv \mu - p.$$

From $u(\bar{c}) = \mathbb{E}[u(x)]$ take a first (second) order Taylor expansion around $x = \mu$ on the LHS (RHS):

$$u(\mu - p) = \mathbb{E}[u(x)],$$

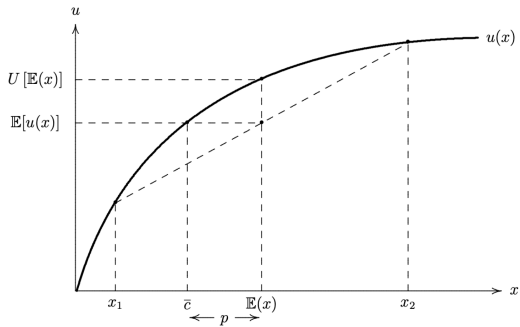
$$u(\mu) + u'(\mu)(\mu - p - \mu) \approx \mathbb{E}\Big[u(\mu) + u'(\mu)(x - \mu) + \tfrac{1}{2}u''(\mu)(x - \mu)^2\Big].$$

$$\Rightarrow \quad p \approx -\frac{1}{2}\frac{u''(\mu)}{u'(\mu)}\sigma^2.$$

The sign of $u''$ (i.e., the curvature of the utility function) determines the sign of the premium that the consumer is willing to pay.

# Risk

Figure 1.1: **Utility curvature and the risk premium**



# Contracts: Background

Players: principal and agent.

- E.g. insurance company (principal) and customer (agent).

Basic idea:

- Principal offers a contract/a menu of contracts (e.g., insurance plans).
- Agent accepts/rejects/chooses the contract and maximizes her expected utility.

Examples:

- **Adverse selection:** principal offers a contract without knowing the agent's type (e.g., insurance company offers a plan without knowing the customer's risk type or health) [note: agent already knows her type when principal offers contract].
- **Moral hazard:** principal offers contract to agent, observes final output but not agent's actions (e.g., firm hires workers, doesn't observe how many hours the worker works, but observes output) [note: agent doesn't have any private information when the principal offers contract].

# Contracts: Background

First vs. second best:

- **First best:** optimal contract without any frictions
  (friction: something unobservable to the principal).
- **Second best:** optimal contract given the friction
  (optimal contract: principal maximizes their objective).

We will focus on “hidden actions”: actions that are partially, but not fully observed by others $\Rightarrow$ leads to moral hazard.

# Roadmap

Introduction

Sharecropping

Multitasking

Evidence

# Sharecropping: Set-up

Sharecropping: a situation where a landowner allows a tenant farmer to work a plot of land in return for a share of the crops produced.

Who are the players? `Farm` (Principal) and `Worker` (Agent).

What are the actions they take, and when? `Farm` commits to a linear piece-rate contract in plot output $x$:

$$w = \gamma + \delta \cdot x \tag{11.1}$$

`Worker` sees the offer $(\gamma, \delta)$ and chooses whether to work on the plot. If working, `Worker` then chooses effort $a > 0$.

# Sharecropping: Set-up

Output $x$ is realized such that

$$x = a + \varepsilon, \tag{1}$$

$$\varepsilon \sim \mathcal{N}(0, \sigma^2). \tag{2}$$

`Farm` observes $x$, but never observes $a$ or $\varepsilon$ separately.

Farm then pays $w$ on the terms agreed.

# Sharecropping: Farm Payoff

**Assumption (PRINCIPAL'S UTILITY)**

`Farm` sells output at price $p$, and pays $w$ if the `Worker` has agreed to the contract. Therefore, profit is:

$$\pi = \begin{cases} p \cdot x - w & \text{if } a > 0, \\ p \cdot \varepsilon & \text{if } a = 0. \end{cases} \tag{3}$$

We assume that `Farm` payoff is simply profit; this implies that `Farm` is risk-neutral.

# Sharecropping: Worker Payoff

**Assumption (AGENT'S UTILITY)**

Effort has quadratic cost $0.5a^2$. `Worker` has exponential utility over net wage $w - 0.5a^2$, with coefficient of absolute risk aversion $r$:

$$u(w, a; r) = -\exp\Big(-r\big(w - 0.5a^2\big)\Big). \tag{4}$$

`Worker` also has an outside option, having certainty equivalent $\underline{u}$, which we will normalise to zero.

# Aside: Certainty Equivalent for CARA utility function

If `Worker`'s net wage has distribution

$$\left(w - \tfrac{1}{2}a^2\right) \sim \mathcal{N}(\mu, \sigma^2),$$

the certainty equivalent is

$$\bar{u} = \mu - \tfrac{1}{2} r \sigma^2.$$

Recall that $\bar{u} = \mu - p$, where $p$ is the risk premium and

$$p = -\frac{1}{2} \frac{u''(\mu)}{u'(\mu)} \sigma^2.$$

In our case: $u' = r \exp(\cdot)$; $u'' = -r^2 \exp(\cdot)$.

Hence,

$$p = -\frac{1}{2} \frac{-r^2 \exp(\cdot)}{r \exp(\cdot)} \sigma^2 = \frac{1}{2} r \sigma^2.$$

Hence,

$$\bar{u} = \mu - \tfrac{1}{2} r \sigma^2.$$

# Sharecropping: Solution Concept

What is the solution concept? **Subgame perfect equilibrium**.

What is the set of best responses? What is the solution?

- Solve by backwards induction.
- `Farm` offers the contract and then `Worker` decides whether or not to accept.
- Hence, start with `Worker` problem.

# Step 1: `Worker`'s optimal effort when $a > 0$

When accepting the contract ($a > 0$), `Worker` solves:

$$\max_{a>0} u(w, a; r).$$

Note that

$$w = \gamma + \delta x = \gamma + \delta a + \delta \varepsilon, \tag{5}$$

$$\varepsilon \sim \mathcal{N}(0, \sigma^2), \tag{6}$$

so

$$w \sim \mathcal{N}\left(\gamma + \delta a,\ \delta^2 \sigma^2\right), \tag{7}$$

and therefore

$$w - 0.5a^2 \sim \mathcal{N}\left(\gamma + \delta a - 0.5a^2,\ \delta^2 \sigma^2\right). \tag{8}$$

# Step 1: `Worker`'s optimal effort when $a > 0$

Therefore, the certainty equivalent $\tilde{u}$ is

$$\tilde{u}(a, \gamma, \delta, \sigma) = \gamma + \delta a - 0.5a^2 - 0.5r\delta^2\sigma^2.$$

(9)

`Worker`'s max problem can therefore be rewritten as

$$\max_{a>0} \gamma + \delta a - 0.5a^2 - 0.5r\delta^2\sigma^2,$$

(10)

which leads to

$$\Rightarrow \quad a^*(\delta, \sigma) = \delta.$$

(11)

# Step 2: Worker's decision to accept or reject

`Worker` will accept the contract iff:

$$\tilde{u} \geq 0. \tag{12}$$

That is,

$$\gamma + \delta a^* - 0.5(a^*)^2 - 0.5r\delta^2\sigma^2 \geq 0, \tag{13}$$

$$\gamma + 0.5\delta^2(1 - r\sigma^2) \geq 0. \tag{14}$$

`Worker`'s best response:

$$a^*(\delta, \sigma, \gamma) = \begin{cases} 0 & \text{if } \gamma + 0.5\delta^2(1 - r\sigma^2) < 0, \\ \delta & \text{if } \gamma + 0.5\delta^2(1 - r\sigma^2) \geq 0. \end{cases} \tag{15}$$

# Step 3: Farm's optimal piece-rate contract

Suppose `Farm` anticipates `Worker`'s response function $a(\delta, \sigma, \gamma)$.

Need to consider both cases ($a = 0$ and $a > 0$):

- If $a(\delta, \sigma, \gamma) = 0$ (i.e., `Worker` does not accept contract, hence no effort), `Farm` pays no wage ($w = 0$) and earns expected profit

$$\mathbb{E}(\pi) = p\,\mathbb{E}(\varepsilon) = 0.$$

- If $a(\delta, \sigma, \gamma) > 0$ (i.e., `Worker` accepts contract, hence effort), `Farm` pays wage $w = \gamma + \delta a(\delta, \sigma, \gamma)$ and earns expected profit

$$\begin{aligned}\mathbb{E}(\pi) &= p\,\mathbb{E}(x) - \mathbb{E}(w) = p\,\mathbb{E}(a) + p\,\mathbb{E}(\varepsilon) - \mathbb{E}(w) \\ &= p\,a(\delta, \sigma, \gamma) - \big(\gamma + \delta a(\delta, \sigma, \gamma)\big) \\ &= (p - \delta)a(\delta, \sigma, \gamma) - \gamma.\end{aligned}$$

# Step 3: Farm's optimal piece-rate contract

Assume (for now) that $(p-\delta)a(\delta,\sigma,\gamma)-\gamma>0$ (i.e., that Farm always wants Worker to agree to the contract) (we will get back to this point later).

We can then write Farm's max problem as a nested optimization

$$(\gamma^*,\delta^*)=\arg\max_{(\gamma,\delta)\in\mathbb{R}^2}\left[(p-\delta)a^*-\gamma\right] \tag{16}$$

subject to

$$\gamma+0.5\delta^2(1-r\sigma^2)\geq 0 \tag{17}$$

$$a^*=\delta. \tag{18}$$

# Step 3: Farm's optimal piece-rate contract

(17): individual rationality constraint (IR).
Ensures participation by Worker ("participation constraint").

(18): incentive compatibility constraint (IC).
Ensures: Worker's expected utility $\geq$ Worker's payoff from other actions (effort) ("effort constraint").

To solve problem, first note that $\pi$ is strictly decreasing in $\gamma$: Farm wants to set $\gamma$ as low as possible (subject to the constraints).

$\gamma$ only enters IR, hence set

$$\gamma^* = 0.5\delta^2(r\sigma^2 - 1).$$

# Step 3: `Farm`'s optimal piece-rate contract

Now `Farm` chooses $\delta$ to maximize

$$\begin{aligned}\pi(\delta) &= (p-\delta)\cdot\delta - 0.5\delta^2(r\sigma^2-1)\\ &= p\cdot\delta - 0.5\delta^2(1+r\sigma^2).\end{aligned}$$

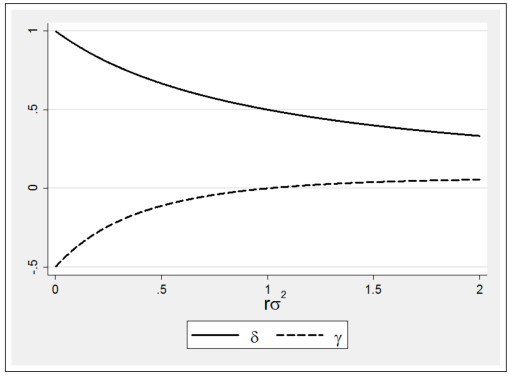
Thus

$$\delta^* = \frac{p}{1+r\sigma^2},$$

and

$$\gamma^* = 0.5p^2\left(\frac{r\sigma^2-1}{(r\sigma^2+1)^2}\right), \quad \pi^* = 0.5\left(\frac{p^2}{1+r\sigma^2}\right).$$

# Optimal $\delta$ and $\gamma$ as functions of $r\sigma^2$ (assuming $p = 1$).



# Roadmap

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# Introducing a second task. . .

So far: `Worker` decided how much effort to exert on a single task.

Now: decides to exert effort on either (or both) of two tasks.

- Effort for task 1: $a_1$ (e.g., same as before: working the fields).
- Effort for task 2: $a_2$ (e.g., selling souvenirs to tourists).

Costs for are quadratic in effort:

$$C = 0.5a_1^2 + 0.5a_2^2. \tag{19}$$

`Worker` has exponential utility:

$$u(w) = -\exp(-rw).$$

# Multitasking: Set-up

`Farm` measures/observes some variable $y$ (a performance measure) which is a weighted sum of `Worker`'s effort:

$$y = \beta_1 a_1 + \beta_2 a_2 + \varepsilon_y, \qquad \varepsilon_y \sim \mathcal{N}(0, \sigma_y^2).$$

`Farm` offers a linear piece-rate contract:

$$w = \gamma + \delta y.$$

Output for `Farm`, before paying `Worker`, is

$$x = a_1 + a_2 + \varepsilon_x, \tag{20}$$

with

$$\varepsilon_x \sim \mathcal{N}(0, \sigma_x^2).$$

# Step 1: `Worker`'s optimal effort (conditional on accepting)

`Worker` solves

$$\max_{a_1, a_2 \geq 0} \gamma + \delta\beta_1 a_1 + \delta\beta_2 a_2 - 0.5a_1^2 - 0.5a_2^2 - 0.5r\delta^2\sigma_y^2,$$

and upon differentiating, we find

$$a_1^* = \delta\beta_1, \qquad a_2^* = \delta\beta_2.$$

# Step 2: `Worker`'s decision to accept or reject

If `Worker` accepts the contract, she will get a certainty equivalent of

$$\begin{aligned}&\gamma + \delta^2\beta_1^2 + \delta^2\beta_2^2 - 0.5\delta^2\beta_1^2 - 0.5\delta^2\beta_2^2 - 0.5r\delta^2\sigma_y^2\\ &= \gamma + 0.5\delta^2\left(\beta_1^2 + \beta_2^2 - r\sigma_y^2\right).\end{aligned}$$

`Worker` should accept the contract if this expression is at least as good as the outside option (giving utility of zero).

# Step 3: `Farm`'s optimal piece-rate contract

Start by solving for $\gamma$ again: keep `Worker` indifferent between accepting and not accepting the contract:

$$\gamma^* = 0.5\delta^2\left(r\sigma_y^2 - \beta_1^2 - \beta_2^2\right).$$

Hence, `Farm`'s expected profit is

$$\begin{aligned}\mathbb{E}(\pi) &= p(a_1 + a_2) - \delta(\beta_1 a_1 + \beta_2 a_2) - 0.5\delta^2\left(r\sigma_y^2 - \beta_1^2 - \beta_2^2\right) \\ &= p\delta(\beta_1 + \beta_2) - 0.5\delta^2\left(\beta_1^2 + \beta_2^2 + r\sigma_y^2\right).\end{aligned}$$

Differentiating, we obtain

$$\delta^* = p\left(\frac{\beta_1 + \beta_2}{\beta_1^2 + \beta_2^2 + r\sigma_y^2}\right).$$

# Farm profit

Expected profit for Farm (still in second best scenario from above) is

$$\pi^* = p\delta(\beta_1 + \beta_2) - 0.5\delta^2\left(\beta_1^2 + \beta_2^2 + r\sigma_y^2\right) = 0.5p^2\left[\frac{(\beta_1 + \beta_2)^2}{\beta_1^2 + \beta_2^2 + r\sigma_y^2}\right].$$

In the first best case, $\beta_1 = \beta_2 = \beta$ and $r\sigma_y^2 = 0$. Then...

$$\pi^* = 0.5p^2\left[\frac{(\beta + \beta)^2}{\beta^2 + \beta^2}\right] = 0.5p^2\left[\frac{(2\beta)^2}{2\beta^2}\right] = p^2.$$

# Loss of Profit

$$p^2 - 0.5p^2\left[\frac{(\beta_1+\beta_2)^2}{\beta_1^2+\beta_2^2+r\sigma_y^2}\right] = p^2\left(\underbrace{\frac{0.5(\beta_1-\beta_2)^2}{\beta_1^2+\beta_2^2+r\sigma_y^2}}_{\text{loss due to misalignment}} + \underbrace{\frac{r\sigma_y^2}{\beta_1^2+\beta_2^2+r\sigma_y^2}}_{\text{loss due to noise}}\right). \quad (21)$$

"The key point here is that if the gross payoff to the principal is not contractible information, then risk neutrality or a noiseless performance measure are not sufficient to achieve the first-best result. The performance measure must also be perfectly congruent."

Feltham and Xie (1994)

# Optimal piece-rates and misalignment of performance measures

Let $p = 1$ for simplicity.

Consider special case where $r\sigma_y^2 = 0$ (i.e., `Worker` is risk neutral). Then

$$\delta^* = \left[\frac{\beta_1 + \beta_2}{\beta_1^2 + \beta_2^2}\right].$$

Recall: for any two vectors $\alpha$ and $\beta$, having angle $\theta$ between them, we have

$$\cos(\theta) = \frac{\alpha\beta}{\|\alpha\| \times \|\beta\|},$$

where $\|x\|$ is the norm of the vector. E.g., if $x = (x_1, x_2)$, then $\|x\| = \sqrt{x_1^2 + x_2^2}$.

# Optimal piece-rates and misalignment of performance measures

Recall that `Farm` profit is simply the sum of effort (plus noise).

Define $\alpha = (1, 1)$ and $\beta = (\beta_1, \beta_2)$, hence

$$\cos(\theta) = \frac{\beta_1 + \beta_2}{\sqrt{2}\sqrt{\beta_1^2 + \beta_2^2}}.$$

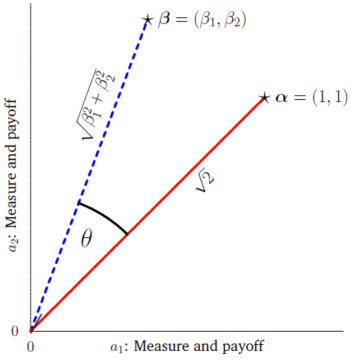
Therefore,

$$\delta^* = \left[\frac{\beta_1 + \beta_2}{\beta_1^2 + \beta_2^2}\right] = \frac{\|\alpha\|}{\|\beta\|} \cdot \cos(\theta).$$

# Optimal piece-rates and misalignment of performance measures

"There are two important features in $\delta^*$: scaling and alignment, reflected by $\|\alpha\|/\|\beta\|$ and $\cos(\theta)$, respectively. Scaling is intuitive but uninteresting. For example, if $\beta_1$ and $\beta_2$ are both much larger than 1, then the efficient contract puts a small bonus rate on $y$, as shown by $\|\alpha\|/\|\beta\|$. Alignment, however, is the key to the model. As one example, if the $\alpha$ and $\beta$ vectors lie almost on top of one another (regardless of their lengths), then the incentives created by paying on $y$ are valuable for increasing $x$. As a second example, if the $\alpha$ and $\beta$ vectors are almost orthogonal to each other, then the incentives created by paying on $y$ are almost useless for increasing $x$. More generally, the efficient contract has a larger bonus rate $\delta^*$ when $\alpha$ and $\beta$ are more closely aligned, as measured by $\cos(\theta)$."

Gibbons (2010)


$\boldsymbol{\beta} = (\beta_1, \beta_2)$
$\sqrt{\beta_1^2 + \beta_2^2}$
$\boldsymbol{\alpha} = (1, 1)$
$\sqrt{2}$
$\theta$
$a_2$: Measure and payoff
0
0
$a_1$: Measure and payoff

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# Burchardi et al. (2019): the setting

A field experiment with BRAC in rural Uganda, run over two agricultural seasons in 2014–15.

BRAC plays the role of `Farm`: it rents plots of roughly half an acre and leases them to young women (`Worker`), along with seeds and agricultural training.

304 tenants sign a contract at the start of Season 1. Treatment is assigned at the village level.

Central design choice: the same 50% sharecropping contract is advertised to everyone, and signed, before anyone learns their treatment.

- Rules out selection of different types of tenant into different contracts (same logic as Karlan and Zinman, 2009).
- Contract changes are announced afterwards, and are always weakly better for the tenant.

# The location

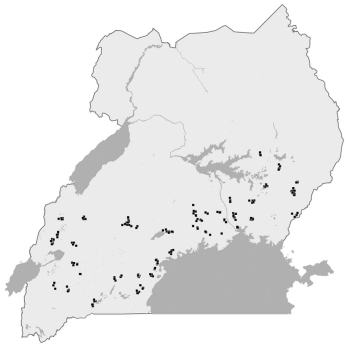

FIGURE I

Location of the Plots.

This map of Uganda uses black squares to show the location of BRAC clubs whose farmers participated in the experiment and are covered in the plot-level analysis.

# The treatments

Everyone starts from $w = \gamma + \delta x$, with $\delta = 0.5$ and $\gamma = 0$. The experiment then moves $\delta$ and $\gamma$ separately:

| Arm | $\delta$ | $\gamma$ | |
|---|---|---|---|
| C: control | 0.5 | 0 | |
| T1: high $\delta$ | 0.75 | 0 | |
| T2A: high $\gamma$, safe | 0.5 | $\bar{\gamma}$ | fixed payment at harvest |
| T2B: high $\gamma$, risky | 0.5 | $\tilde{\gamma}$ | lottery, $\mathbb{E}[\tilde{\gamma}] = \bar{\gamma}$ |

$\bar{\gamma}$ is calibrated to roughly 25% of the median harvest value of the previous season — i.e. to approximate the extra expected income that T1 tenants receive.

Output is measured pre-harvest by agronomy students: tenants who owe a share of output have an incentive to under-report it, and that incentive differs by $\delta$.

# What each comparison identifies

Recall the model: $a^*(\delta) = \delta$, and $\gamma$ enters only the IR constraint. Effort responds to the piece rate, not to the fixed component.

- **T1 vs. C:** the effect of raising $\delta$ — the Marshallian incentive effect. But a higher $\delta$ also raises expected income, so this is not a clean test.
- **T2 vs. C:** the effect of raising $\gamma$ alone. The model predicts zero. If the data agree, then T1 $-$ C is the pure incentive effect.
- **T2B vs. T2A:** same expected transfer, different risk — does the *riskiness* of income matter for behaviour?

# Empirical evidence on share-cropping costs from Buchardi et al.

TABLE II

EFFECTS ON OUTPUT

| | Output, $y$ | | Yield, $\frac{y}{a^2}$ | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| High $s$ (T1) | 56.28*** | 56.07*** | 0.074** | 0.073** |
| | (18.52) | (18.58) | (0.031) | (0.031) |
| | [0.004] | [0.004] | [0.024] | [0.027] |
| High $w$ (T2) | 5.36 | | −0.000 | |
| | (17.17) | | (0.030) | |
| | [0.765] | | [0.995] | |
| High $w$, safe (T2A) | | 18.29 | | 0.043 |
| | | (25.84) | | (0.048) |
| | | [0.543] | | [0.403] |
| High $w$, risky (T2B) | | −7.25 | | −0.043 |
| | | (15.82) | | (0.032) |
| | | [0.641] | | [0.206] |
| $H_0$: T1 = T2 | 0.023 | | 0.046 | |
| $H_0$: T1 = T2A | | 0.218 | | 0.590 |
| $H_0$: T1 = T2B | | 0.001 | | 0.002 |
| $H_0$: T2A = T2B | | 0.343 | | 0.120 |
| Mean outcome (C) | 95.13 | 95.13 | 0.174 | 0.174 |
| Observations | 473 | 473 | 473 | 473 |

*Notes.* The table reports ordinary least square estimates based on specification (4) at the plot level for Season 1 and Season 2. *Output*, $y$ is the expected output of the plot measured through the preharvest crop assessment survey. It is calculated by multiplying the expected quantity of output of each crop with the price of the relevant crop measured on local markets, and summing over crops. *Yield*, $\frac{y}{a^2}$ is the expected output of the plot divided by the area (in square meters) cultivated. Values are in PPP US$. T1 is a dummy variable equal to 1 if the tenant/plot was randomized to receive high (75%) output share, T2 is a dummy variable equal to 1 if the tenant/plot was randomized to receive the same output share as control (50%) and an additional cash transfer. T2A and T2B indicate subgroups of treatment group 2 (T2). T2A received a fixed income transfer, and T2B received a stochastic income transfer, with mean equal to T2A. All specifications control for strata fixed effects. Standard errors are clustered at the village level and given in parentheses. In square brackets, randomization inference $p$-values of the null hypothesis of no effect are provided; *** (**) (*) indicates significance of that test at the 1% (5%) (10%) levels. In addition, randomization inference $p$-values for the specified compound hypotheses are reported.

# References

I followed Simon Quinn's presentation of this material. You can check Simon's extensive lecture notes here.