Does trustworthiness matter in an optimal contract?

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Motivation

An unexplained upward trend in hiring length?

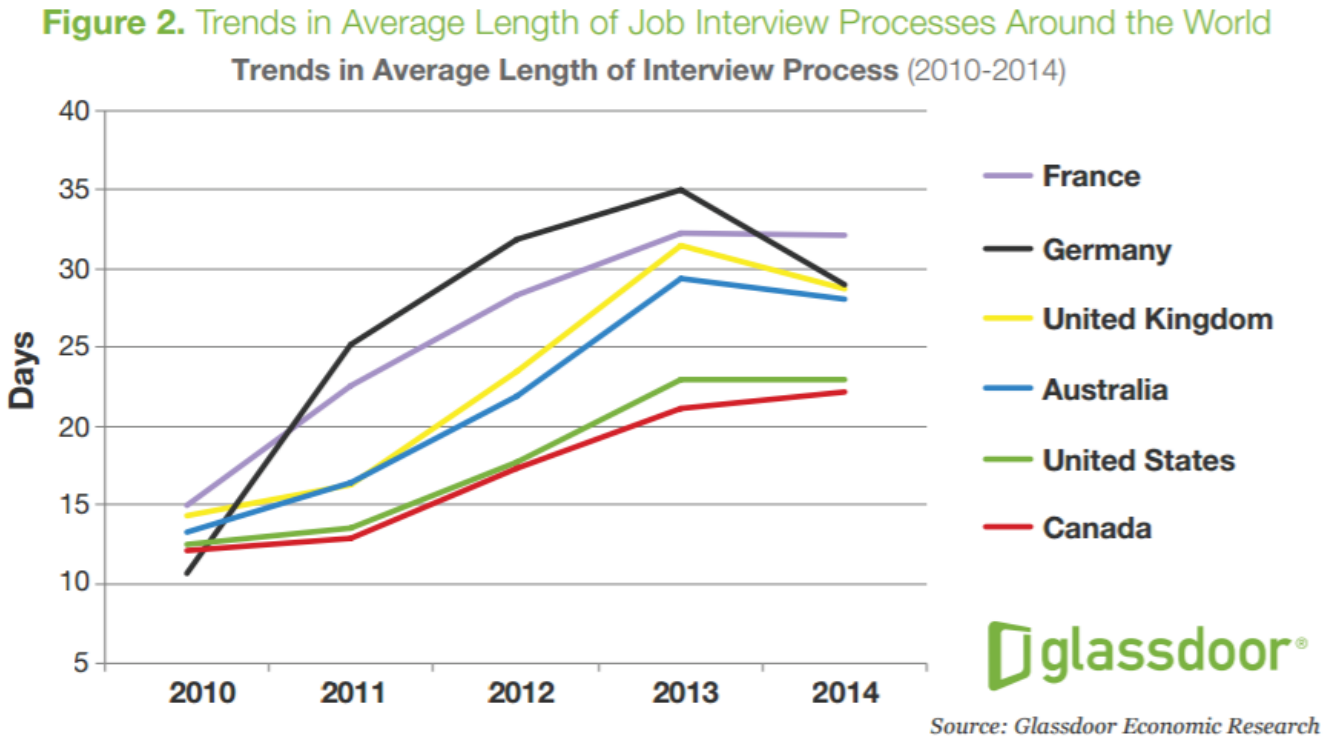


Figure: "...once we carefully control for these confounding factors we still find an upward trend in hiring times of roughly 3.3 to 3.7 days since 2009..."–Glassdoor

Motivation

- Candidates are facing more screening methods than in the past.
  - Survey and tests
  - Multiple rounds of interviews
  - Background check
  - Asking for social media accounts
- Offer internship for their potential employees
- Provide trainings for potential agents during trial periods or for further promotion

Motivation

- Is it possible to design a contract, based on information in agents' willingness-to-reciprocate?
- This can be an important question, especially in sectors where moral hazard is a severe issue.
- Most universities in China provide performance based incentives (paid according to hours taught and paper published). Anecdotally, those incentives may hurt intrinsic motivations.
- Why not more fixed rate pay?

Introduction

- We experimentally test a moral hazard game:
  - Elicit trustworthiness in the first stage.
  - In the second stage, firms decide a linear wage schedule and employees choose effort.
  - Firms may access info on employees' trustworthiness measure.
- Research Question: How do principals react to information on trustworthiness information?
- Research Question: How does the effect of individual level information affect the game outcome/ equilibrium.

Literature

- Trust Games
  - "social capital"–Knack and Keefer 1997
  - A simple game measuring pure trust–Berg et al 1995 (link discussed in Glaeser et al 2000)
  - General Result: 50% invested; few 0 investors; 95% of the investment repaid on average–with a wide dispersion
  - Many replications world-wide: Koford 1998 (Bulgarian sample), Willinger et al 1999 (French and German), Ensminger 2000 (Kenyan)
  - Johnson and Mislin 2011: a meta-analysis of 162 replications
- Does trust game measure trustworthiness (or altruism / unconditional other regarding preferences)?
  - Cox 1999, Dufwenberg and Gneezy 2000, Cox 2004, Bartolomeo and Papa 2016
  - General Result: A small (yet significant) amount of repayment is owning to positive reciprocity.

Literature

Descriptive statistics by region.

Variable name	Obs.	Sum *N*	Mean
Panel A: Sent fraction (trust)			
All regions	161	23,900	0.502
North America	46	4579	0.517
Europe	64	9030	0.537
Asia	23	3043	0.482
South America	13	4733	0.458
Africa	15	2515	0.456
Panel B: Proportion returned (trustworthiness)			
All regions	137	21,529	0.372
North America	41	4324	0.340
Europe	53	7596	0.382
Asia	15	2361	0.460
South America	13	4733	0.369
Africa	15	2515	0.319

Figure: Trust Games by Regions (from Johnson and Mislin 2011, Table 2)

Literature

- Gift exchange
  - Fehr et al 1993, Fehr and Gächter 2000, Charness 2004, Falk et al 2006
  - General Result: Firms offer large wages and workers reciprocate by working hard
  - General Result: Explicit incentives (Minimum effort, fines with probabilistic detection) may backfire
- Piece rate and fixed rate
  - Swenson 1988, Sillamaa 1999a,b, Gneezy and Rustichini 2000, Ariely et al 2008, Cadsby et al 2009, Goto et al 2015
  - General Result: highly non-monotonic, heterogeneous effect of incentives
  - Anderhub, Gächter, and Königstein 2002
  - General Result: a high degree of incentive-compatible behavior, but also ‘fair sharing’ and reciprocity.

Literature

- (More) features in Labor Markets
  - This paper allows flexible wage design (Anderhub et al 2002) and uncertainty in costly production (Rubin and Sheremeta 2016).
- Moral hazard model with reciprocal agents modeled
  - This paper is inspired by theory developed by Englmaier and Leider 2012

Preliminary results

- With individual information on trustworthiness, employers reward trustworthiness significantly.
- Meanwhile they offer low piece rate in general, and even lower for less trustworthy employees.
- In the individual information treatment, employees are more self regarding than employers expect, leading to lower effort and output.

The agent is reciprocity enabled

- Markets of one employer and one employee
- (Risk Neutral) agent chooses the effort level to maximize

$$\pi^{\mathrm{A}}(\mathrm{e}; \mathrm{w}(\mathrm{q}), \epsilon, \lambda) = \mathrm{u}^{\mathrm{A}}(\mathrm{e}; \mathrm{w}(\mathrm{q})) + ... \\ ... + \lambda(\mathrm{u}^{\mathrm{A}}(\mathrm{e}; \mathrm{w}(\mathrm{q})) - \mathrm{u}_0^{\mathrm{A}})\mathrm{u}^{\mathrm{P}}(\mathrm{e}; \mathrm{w}(\mathrm{q}))$$

-

$$\pi^{\mathrm{A}} = \mathrm{w} + \beta \mathrm{Eq}(\mathrm{e}, \epsilon) + \lambda \cdot \mathrm{I}(\mathrm{w} + \eta\beta > \mathrm{K}) \cdot \pi^{\mathrm{P}} - \mathrm{cost}(\mathrm{e})$$

The labor market (risk neutral agents)

- Each employer makes decisions on a fixed (base) component and a piece-rate (bonus) component.
- Problem of the employer:

$$\begin{aligned}
&\mathrm{Max}_{\mathrm{w(q,\lambda)}}\ \pi^{\mathrm{p}} = \alpha \mathrm{q}(\mathrm{e}, \epsilon) - \mathrm{w}(\mathrm{q}, \lambda) \\
&\qquad \mathrm{e} \in \underset{\mathrm{e}}{\mathrm{argmax}}\, \mathrm{E}_{\epsilon}[\pi^{\mathrm{A}}(\mathrm{e}; \mathrm{w}(\mathrm{q}), \lambda)] \\
&\qquad \mathrm{E}_{\epsilon}[\pi^{\mathrm{A}}(\mathrm{e}; \mathrm{w}(\mathrm{q}), \eta)] \geq 0 \\
&\qquad \mathrm{w}(\mathrm{q}, \lambda) = \mathrm{w} + \beta \mathrm{q}(\mathrm{e}, \epsilon)
\end{aligned}$$

A specific example (to test)

- $\pi^{\mathrm{p}} = \alpha \cdot \mathrm{Eq}(\mathrm{e}, \epsilon) - \mathrm{w}(\mathrm{q}, \lambda)$

  $\alpha = 80$

  $\mathrm{Eq}(\mathrm{e}, \epsilon) = 10\mathrm{e}$

  $\mathrm{w}(\mathrm{q}, \lambda) = \mathrm{w} + \beta \mathrm{Eq}(\mathrm{e}, \epsilon) = \mathrm{w} + 10\beta \cdot \mathrm{e}$

- $\pi^{\mathrm{A}} = \mathrm{w} + \beta \mathrm{Eq}(\mathrm{e}, \epsilon) + \lambda \cdot \mathrm{I}(\mathrm{w} + \eta\beta > \mathrm{K}) \cdot \pi^{\mathrm{P}} - \mathrm{cost}(\mathrm{e})$

  $\mathrm{Eq}(\mathrm{e}, \epsilon) = 10\mathrm{e}$

  $\mathrm{cost}(\mathrm{e}) = 50 \times \mathrm{e}^2$

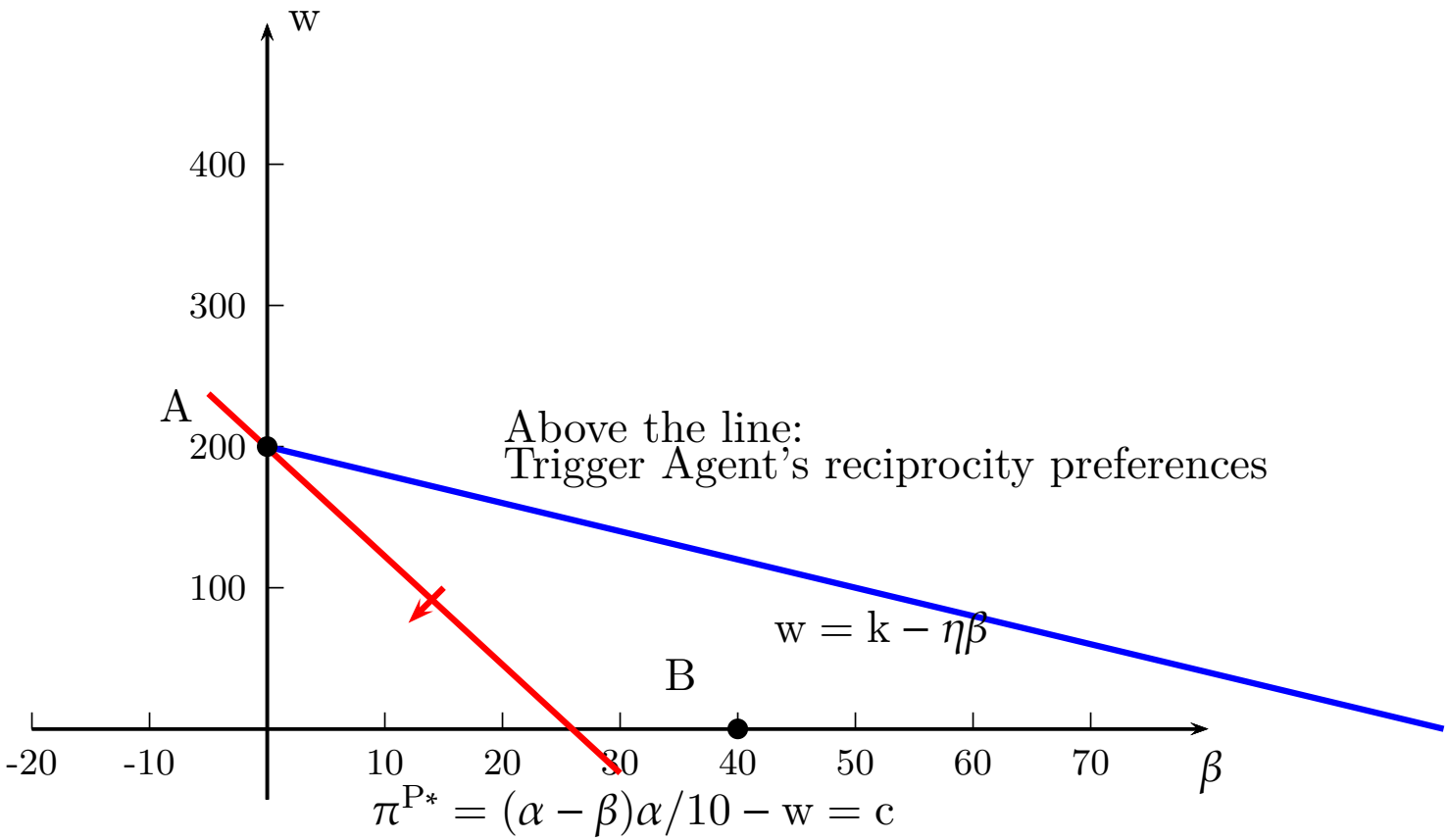
- $\pi^{\mathrm{Social}} = \alpha \cdot 10 \cdot \mathrm{e} - 50 \times \mathrm{e}^2 \Rightarrow \mathrm{e}^{\mathrm{Social}} = \alpha/10$

Optimal strategy

- Agent's optimal strategy:
  $\pi^{\mathrm{A}} = \mathrm{w} + \beta \mathrm{Eq}(\mathrm{e}, \epsilon) + \lambda \cdot \mathrm{I}(\mathrm{w} + \eta\beta >= \mathrm{K}) \cdot \pi^{\mathrm{P}} - 50\mathrm{e}^2$
  - When $\mathrm{w} + \eta\beta < \mathrm{K}$, $\mathrm{e}^* = \beta/10$
  - When $\mathrm{w} + \eta\beta \geq \mathrm{K}$, $\mathrm{e}^* = (\lambda\alpha + (1-\lambda)\beta)/10$
- Principal's optimal strategy:
  $\pi^{\mathrm{p}} = (\alpha - \beta) \cdot \mathrm{Eq}(\mathrm{e}, \epsilon) - \mathrm{w}$
  - When $\mathrm{w} + \eta\beta < \mathrm{K}$,
    $\beta^* = \alpha/2$, $\mathrm{w}^* = 0$, $\mathrm{e}^* = \alpha/20$
  - When $\mathrm{w} + \eta\beta \geq \mathrm{K}$:
    - and $\lambda <= \frac{\alpha+\eta}{2\alpha}$,
      $\beta^* = \frac{(1-2\lambda)\alpha+\eta}{2(1-\lambda)}$, $\mathrm{w}^* = \mathrm{k} - \eta\beta$, $\mathrm{e}^* = \alpha/20 + \frac{\eta}{20}$
    - and $\lambda > \frac{\alpha+\eta}{2\alpha}$,
      $\beta^* = 0$, $\mathrm{w}^* = \mathrm{k}$, $\mathrm{e}^* = \lambda \cdot \alpha/10$

Example when $\lambda = 1$

Figure: Principal's Optimal Solution under Linear Reciprocity Index Function



The labor market: risk averse agents

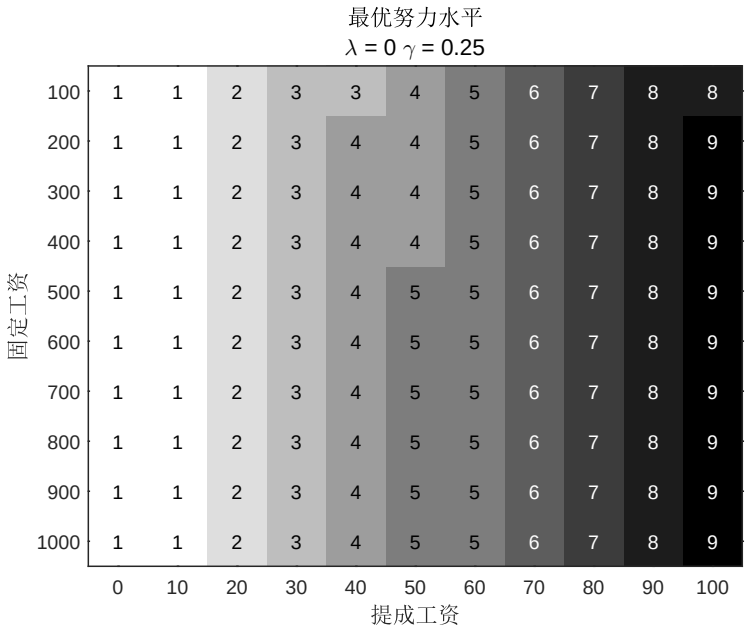
- $\pi^{\mathrm{A}} = \mathrm{U_l} \cdot \mathrm{prob}(\epsilon = \mathrm{l}) + \mathrm{U_h} \cdot \mathrm{prob}(\epsilon = \mathrm{h})$

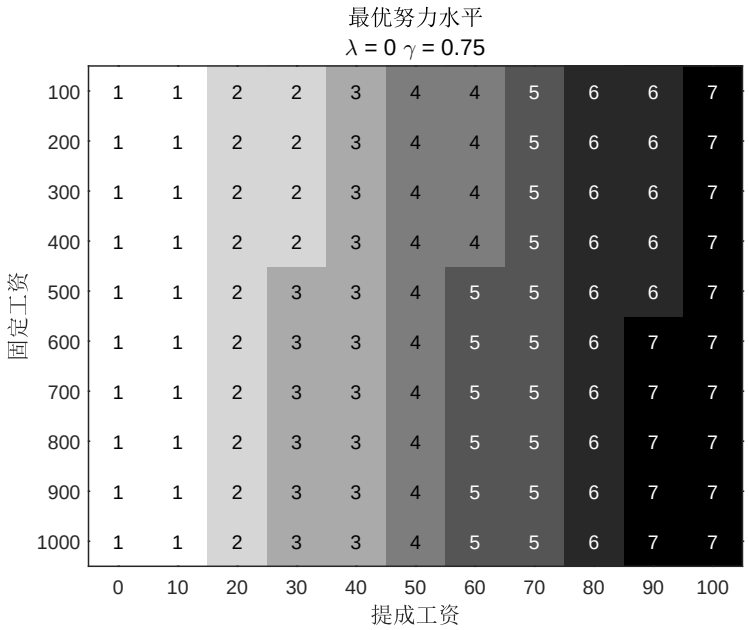
$$\mathrm{U_l} = \mathrm{U}(\beta \mathrm{Eq_{low}} + \lambda \cdot \mathrm{I}(\mathrm{w} + \eta\beta > \mathrm{K}) \cdot \pi^{\mathrm{P}}_{\mathrm{low}} - 50\mathrm{e}^2)$$

$$\mathrm{U_h} = \mathrm{U}(\beta \mathrm{Eq_{high}} + \lambda \cdot \mathrm{I}(\mathrm{w} + \eta\beta > \mathrm{K}) \cdot \pi^{\mathrm{P}}_{\mathrm{high}} - 50\mathrm{e}^2)$$

- Consider the CRRA utility function $\frac{\mathrm{x}^{1-\theta}-1}{1-\theta}$ and assume that agents avoid loss, their optimal strategy can be calculated numerically.

The labor market: risk averse agents





- Risk averse leads to lower effort provision.
- For self-regarding case, the principal prefers using piece rate wage, when agents are slightly risk averse ($\gamma \leq 0.38$).
- For self-regarding case, the principal prefers using some fixed wage, when agents are more risk averse.

Hypotheses

- The principal uses positive fixed wage and the fixed wage is positively correlated with trustworthiness.
- The principal uses less piece rate and the piece rate is negatively correlated with trustworthiness and risk averse.
- Optimal effort level may/ may not depend on trustworthiness measure.

Experimental design: Stage 1

Each employer (labeled with "Role A") and each employee (labeled with "Role B") randomly match:

- 1 round of Trust Game with Strategy Method
- Hold feedback till the end of the experiment
- At this stage, subjects are only told about the existence of Stage 2 without further instructions
- Asymmetric Endowment for the Trust Game:
  - Role A with 20 tokens and Role B with 0 tokens

Design: Measuring Trustworthiness

Experimental design: Stage 2

- In stage 2, Role A receive information based on treatments:
  - Individual Information Treatment: Role A in Stage 2 can review Role B's behavior in Stage 1
  - Social Information Treatment: Role A in Stage 2 can review the average of all role Bs' behavior in Stage 1
- At the end of each period, both Role A & B receive feedback on each role's payoff, as well as the realized production.
- Both Role A and Role B can choose not playing the game, but this option is rarely observed.
- A total of 15 rounds contract game are played and participants randomly rematch each period.

Design: Role A

1.你是角色A。你将向随机配对的参与者（角色B）提供一项任务合同。

2.你可以选择该任务的**固定工资**和**生产提成工资**。你的**总工资支付**为： 固定工资+ 提成工资*产量。

3.该工作任务的产量取决与角色B的**努力程度**和**随机因素**。

4.：在50% 可能性下， 产量= 5 * 努力；在 50% 可能性下， 产量 = 15 * 努力。

5. 角色B努力程度（1-10）所对应的成本为：50, 200, 450, 800, 1250, 1800, 2450, 3200, 4050, 5000。

6.你的最终净收益为：80*本期产量 -（总工资支付）

我选择的固定工资为 [ ] (100, 200. . . , 1000)

我选择的加成工资为 [ ] (0,10,...,100)

回上一页 提交

序号	角色A转移	角色B获得	角色B转回
1	1	3	0
2	2	6	1
3	3	9	2
4	4	12	3
5	5	15	4
6	6	18	5
7	7	21	6
8	8	24	7
9	9	27	8
10	10	30	10
11	11	33	12
12	12	36	14
13	13	39	16
14	14	42	18
15	15	45	20
16	16	48	22
17	17	51	24
18	18	54	26
19	19	57	28
20	20	60	30

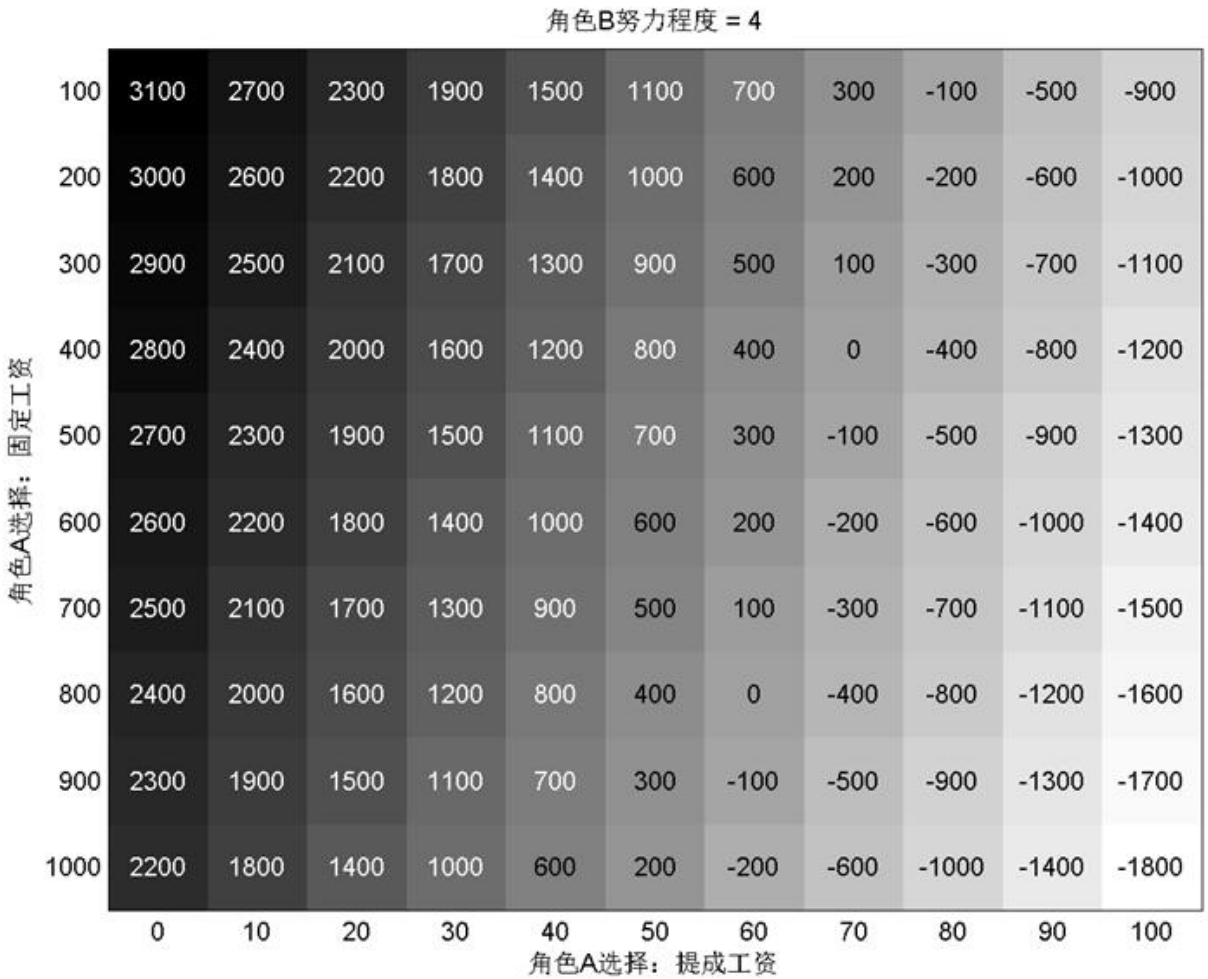
上图为本期和你配对的角色B在第一阶段中的决策信息。

Design: Role B

Experimental design: additional reference and payment

- In order to help subjects understand the game in Stage 2, we made additional information available for subjects:
  - Each Role A has access to a reference booklet, which provides information on the cost of effort and on expected payoffs at all choice scenarios.
  - Each Role B has access to the effort-cost table, as well as possible productions for each effort input.
  - Short quizzes are given at the end of the instruction to make sure they understand the game.
- Subject payment depends on Stage 1, a randomly selected round in Stage 2 and the Show-up fee.

Design: payoff look-up table



Experimental design: parameter choices

- Parameter choices
  - We set $\alpha = 80$ and production shock is 5 with 50% probability and 15 for the rest of the time.
  - The total surplus to split between employer and employee is 400*e or 1200*e.
  - $w \in \{100, 200, ..., 1000\}$, $\beta \in \{0, 10, 20...., 100\}$
  - $e \in \{1, 2, ..., 10\}$, while the wage rent ranges between $(w + 5 * \beta * e - 50e^2, w + 15 * \beta * e - 50e^2)$; the participation constraint is checked and satisfied.

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- Tests:
  - $\mathrm{w}_{\mathrm{ind}} > \mathrm{w}_{\mathrm{soc}}$ for "trustworthy" agents
  - $\frac{\partial \mathrm{w}_{\mathrm{ind}}}{\partial \mathrm{tw}} > 0$
  - $\beta_{\mathrm{ind}} < \beta_{\mathrm{soc}}$ for "trustworthy" agents
  - $\frac{\partial \beta_{\mathrm{ind}}}{\partial \mathrm{tw}} > 0$
  - Conditional on wage incentives, optimal effort may or may not depend on tw

Experimental sessions

- 82 participants have participated the experiments. They are undergraduate and master students from UESTC.
- Webchat based recruit system–"Keyan Assistant"
- Recorded hypothetical risk preference (Eckel and Grossman 2008), and CRT scores (Frederick 2005).

Sss'n	Treatment	Place	Participants
1-4	Asymm, Social, High Cost	UESTC	52(10,10,12,20)
5-6	Asymm, Individual, High Cost	UESTC	30 (12, 18)

- New results will be updated later.