A Theoretical and Experimental Valuation of Pay Transparency Policies

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Outline

Motivation

- Employers are under pressure to disclose pay information.
- Pay scale disclosure laws have morphed in the United States since 2018 (Hendrikson, 2022).
- In the private sector, there is an on-going debate about if a firm should disclose employee compensation (Heskett, 2018)

Motivation

If yes, should a firm disclose the range, the average, or individual pay?

- Few advocates push for "full information" disclosure
  - controversial (Mas, 2017; Cullen and Perez-Truglia, 2020).
- A majority support "aggregate information" disclosure
  - i.e. the range, the average, or the median of salary;
  - less privacy-invasive.

Motivation

Disclosing pay information will give rise to social comparison:

- ahead seeking;
- behind aversion;

which can affect an agent's effort and performance.

Questions

- Would pay information entice agents to increase their efforts and performance?
- What is the impact of social comparison on an agent's effort decision?
- Would offering more granular information entice agents to boost their efforts and performance?
- How does the effects of the pay transparency policies vary under different equity conditions?

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Main Results

- We examine and compare the agent's effort and performance under three pay information disclosure policies:
  - No information policy (N)
  - Aggregate information policy (A)
  - Full information (F)
- Interactive effect with two payment schemes:
  - Pay Equity (E)
  - Pay Inequity (I)

Main Results

- Subjects perform significantly better when pay related information is provided, regardless of the information type, than under the no information policy.
- When subjects are under impartial pay, we find no significant difference in subjects' performance between the Aggregate and the Full information policies.
  - We find the tendency of behind aversion in both transparency policies.
- When there is unfairness in the payment scheme, the Full information policy induces substantially more improvement in the performances than the Aggregate information policy.
  - The patterns of social comparison are much weaker and less consistent across the two types of transparency policies.

Outline

Agent's problem

- n agents with heterogeneous abilities $a_i = \{a_L, a_H\}$
- Prior belief about the probability of an agent's ability p_H (p_L)
- Effort (agent's decision): e_i
- Effort cost: $\frac{1}{2}ce_i^2$
- Performance: $x_i = a_i + e_i + \epsilon_i,\ \ i = 1, 2, ..., n,\ \epsilon_i \overset{i.i.d}{\sim} N(0, \sigma^2)$
- Pay: $w_i = w_0 + \alpha x_i = w_0 + \alpha(a_i + e_i + \epsilon_i),\ \ i = 1, 2, ..., n$
- No information:

$$\max_{e_i} \mathbb{E}[w_0 + \alpha(a_i + e_i + \epsilon_i) - \tfrac{1}{2}ce_i^2],\ \ i = 1, 2, ..., n$$

$$\Rightarrow \qquad e_i^* = e_N^* = \frac{a_i}{c}$$

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Agent's problem under agg-info disclosure policy (A)

- Agent i's problem in the first stage under policy A is

$$\max_{e_i} \mathbb{E}[(w_0 + \alpha(a_i + e_i + \epsilon_i) - \frac{1}{2}ce_i^2)$$
$$+ \underbrace{\alpha h(a_i + e_i + \epsilon_i - \frac{(n-1)[p_L(a_L + e_{AL}^*) + p_H(a_H + e_{AH}^*)] + \sum_{j\neq i}\epsilon_j + a_i + e_i + \epsilon_i}{n})^+}_{\text{utility gain from the ahead seeking effect}}$$
$$\underbrace{- \alpha k(\frac{(n-1)[p_L(a_L + e_{AL}^*) + p_H(a_H + e_{AH}^*)] + \sum_{j\neq i}\epsilon_j + a_i + e_i + \epsilon_i}{n} - (a_i + e_i + \epsilon_i))^+}_{\text{utility loss from the behind averse effect}}$$

Agent's problem under agg-info disclosure policy (A)

- Optimal first stage effort:

$$\begin{cases} \alpha - ce^*_{AL} + \frac{\alpha h(n-1)}{n} \int_{\sqrt{\frac{n-1}{n}} p_H(\Delta_a+\Delta_e)}^{+\infty} f(z)dz + \frac{\alpha k(n-1)}{n} \int_{-\infty}^{\sqrt{\frac{n-1}{n}} p_H(\Delta_a+\Delta_e)} f(z)dz = 0 \\ \alpha - ce^*_{AH} + \frac{\alpha h(n-1)}{n} \int_{\sqrt{\frac{n-1}{n}} p_L(\Delta_a+\Delta_e)}^{+\infty} f(z)dz + \frac{\alpha k(n-1)}{n} \int_{-\infty}^{\sqrt{\frac{n-1}{n}} p_L(\Delta_a+\Delta_e)} f(z)dz = 0 \end{cases} \tag{1}$$

where $\Delta_a = a_H - a_L$, $\Delta_e = e^*_{AH} - e^*_{AL}$.

- Compared with e^*_N

Corollary 1

Under the aggregate information disclosure policy A, irrespective of the prior belief p_L and p_H, we have $\Delta_a + \Delta_e > 0$ and

1. *when $h \geq k$, $e^*_{AH} > e^*_{AL} > e^*_N$;*
2. *when $k > h$, $e^*_{AL} > e^*_{AH} > e^*_N$.*

- The optimal effort is greater under policy A than policy N.

Agent's problem under agg-info disclosure policy (A)

- Each agent update his belief (P_H and P_L).
- We abstract away the belief updating process and assume the following
  - an agent having observed a lower average performance than his own would have $P_H < p_H$.
- Replacing p_H with P_H in equation (1), we obtain

Corollary 2

Under the aggregate information disclosure policy A, the optimal efforts in the second stage satisfy:

$$\begin{cases} \frac{\partial e^*_{Ai}}{\partial P_H} < 0 & \text{if } h \geq k \\ \frac{\partial e^*_{Ai}}{\partial P_H} \geq 0 & \text{if } k > h, \end{cases} \quad i = L, H.$$

Agent's problem under full-info disclosure policy (F)

- Agent i's problem in the first stage under policy F is

$$\max_{e_i} \mathbb{E}\Big[(w_0 + \alpha(e_i + a_i + \epsilon_i) - \frac{1}{2}ce_i^2) + \underbrace{\sum_{j\neq i} \frac{\alpha h}{n}(e_i + a_i + \epsilon_i - p_L(e_L^* + a_L) - p_H(e_H^* + a_H) - \epsilon_j)^+}_{\text{utility gain from the ahead seeking effect}} - \underbrace{\sum_{j\neq i} \frac{\alpha k}{n}(p_L(e_L^* + a_L) + p_H(e_H^* + a_H) + \epsilon_j - e_i - a_i - \epsilon_i)^+}_{\text{utility loss from the behind averse effect}}.$$

Agent's problem under full-info disclosure policy (F)

- Optimal first stage effort:

$$\begin{cases} \alpha - ce^*_{FL} + \frac{\alpha h(n-1)}{n} \int_{\sqrt{\frac{1}{2}}p_H(\Delta_a+\Delta_e)}^{+\infty} f(z)dz + \frac{\alpha k(n-1)}{n} \int_{-\infty}^{\sqrt{\frac{1}{2}}p_H(\Delta_a+\Delta_e)} f(z)dz = 0 \\ \alpha - ce^*_{FH} + \frac{\alpha h(n-1)}{n} \int_{\sqrt{\frac{1}{2}}p_L(\Delta_a+\Delta_e)}^{+\infty} f(z)dz + \frac{\alpha k(n-1)}{n} \int_{-\infty}^{\sqrt{\frac{1}{2}}p_L(\Delta_a+\Delta_e)} f(z)dz = 0 \end{cases} \quad (2)$$

where $\Delta_a = a_H - a_L$, $\Delta_e = e^*_{FH} - e^*_{FL}$.

- Compared with e^*_N

Corollary 3

Under the full information disclosure policy F, irrespective of the prior belief p_L and p_H, we have $\Delta_a + \Delta_e > 0$ and

1. *when $h \geq k$, $e^*_{FH} > e^*_{FL} > e^*_N$;*
2. *when $k > h$, $e^*_{FL} > e^*_{FH} > e^*_N$.*

- The optimal effort is greater under policy F than policy N.

Agent's problem under full-info disclosure policy (F)

- Using the same approach, we get

Corollary 4

Under the full information disclosure policy F, the optimal efforts in the second stage satisfy:

$$\begin{cases} \frac{\partial e^*_{Fi}}{\partial P_H} < 0 & \text{if } h \geq k \\ \frac{\partial e^*_{Fi}}{\partial P_H} \geq 0 & \text{if } k > h, \end{cases} \quad i = L, H.$$

Effort comparison

- Pay Equity:

Corollary 6

Suppose each agent has the same updated belief P_H under policies A and F. Then the optimal efforts under these two policies possess the following properties:

1. *When $h \geq k$, $e^*_{AL}(P_H) < e^*_{FL}(P_H)$ and $e^*_{AH}(P_H) > e^*_{FH}(P_H)$;*
2. *When $k > h$, $e^*_{AL}(P_H) > e^*_{FL}(P_H)$ and $e^*_{AH}(P_H) < e^*_{FH}(P_H)$.*

- On the individual level, the comparison of e^* depend on the ability type and the comparison between the ahead seeking and the behind averse effects.
- If we assume $h = k$, then policies (A) and (F) will generate similar efforts.

Effort comparison

- Pay Inequity: We model inequality by setting heterogeneous piece rate α_H and α_L.
- To summarize, the model prediction indicates that in the presence of heterogeneous piece rates, agents with low (high) pay will exert a higher (lower) effort level than when there is no heterogeneous piece rates.
- In comparison between the full policy and the aggregate policy, we get similar results as that shown in Corollary 6.

Hypotheses based on performance

- Performance can be observed without noise.

Hypothesis 1

Under Pay Equity (E), relative to the No information policy (N), agents perform significantly better under the pay transparency policy (A) or (F).

- Based on Corollary 6 and the fact $E(x_i) = a_i + e_i$.

Hypothesis 2

Under Pay Inequity (I), relative to the No information policy (N), agents perform significantly better under the pay transparency policy (A) or (F).

- Based on Corollary 9 and the fact $E(x_i) = a_i + e_i$.

Hypotheses based on performance

Hypothesis 3

Under either Pay Equity (E) or Pay Inequity (I), there is no significant difference in agents' performance between the aggregate policy (A) and the full policy (F).

- Based on Corollaries 6 and 9 and the fact $E(x_i) = a_i + e_i$, assuming a relatively equal distribution of the ability types.

Outline

Procedure

- In total 198 university student subjects participated.
- Each session consisted of
  - two practice rounds;
  - eight paying rounds;
  - a demographic questionnaire.
- In each round, a real-effort task, then a one-minute break.
- A treatment-specific feedback was provided during the break.
- Subjects earned experimental token in each paying round.
- Each subject was paid in real money according to his performance in each of the 8 rounds. One paying round were randomly selected to be paid for real at the end.

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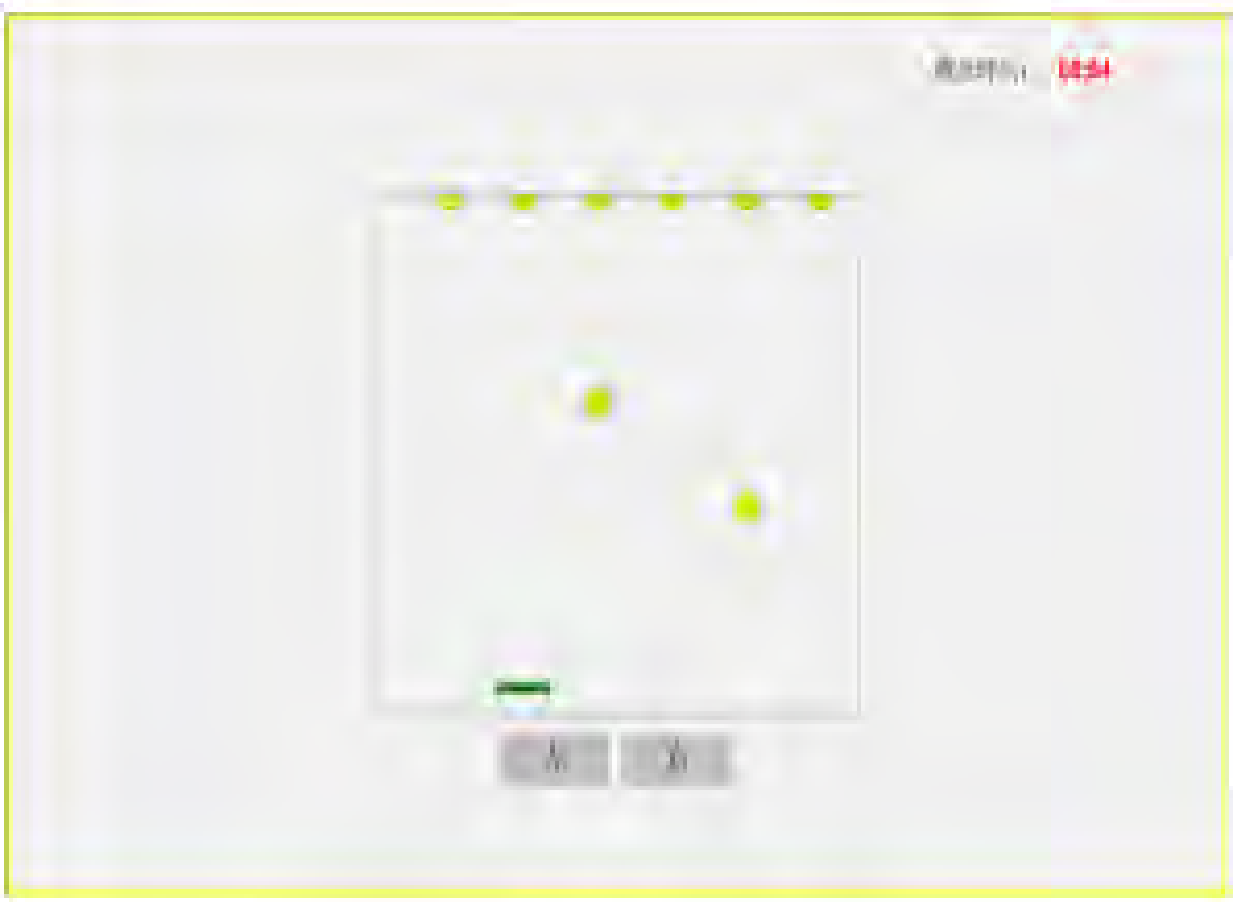
The real effort task

- A ball catching game (Gächter et al. 2016):
  - Click the "left" or "right" button to move a "tray" to catch balls that fall at fixed time intervals on the screen.



The real effort task

- The task lasted for one minute in each paying round:
  - Terminating, pausing or restarting the task was not allowed.
- Two practice rounds:
  - The first lasted for five-minute, allowed to be ended earlier.
  - The second lasted for one-minute, identical to each paying round.
  - No feedback was provided for either practice round.

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Treatments

- Subjects were divided into groups of 11 before the official rounds start,
  - same group assignment throughout the experiment;
  - a random English letter was given as the code name.
- Groups were further divided into 2×3 treatments, varying in two dimensions.

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Treatments

- In the first dimension, we manipulate the feedback subjects received during the one-minute break:
  - No information policy (N);
  - Aggregate information policy (A);
  - Full information policy (F).
- In the second dimension, our experiment involved different pay equity conditions (E) and (I):
  - Pay Equity (E): Each subject earns 1 ET for catching a ball during each round;
  - Pay Inequity (I): Among the 11 subjects in a group, 3 earns 1.3 ET while the rest of the group earn 1 ET for catching a ball during each round.

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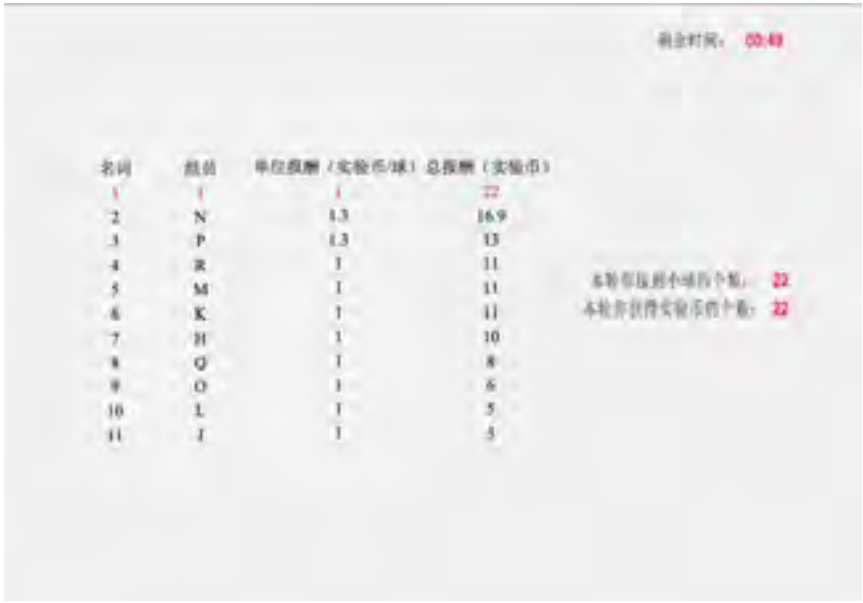
Treatments

(a) Aggregate information policy



(b) Full information policy

Figure: Treatment-specific feedback

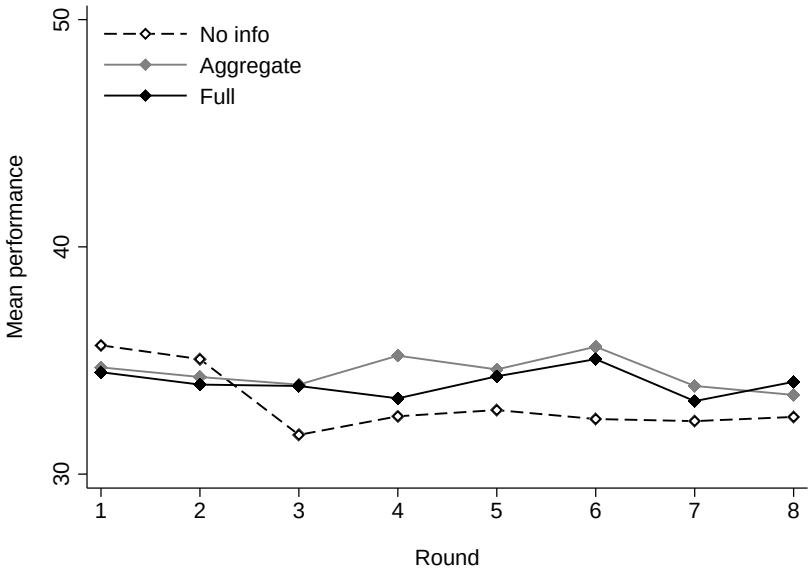
Group assignments

Table: Group assignments of 198 subjects.

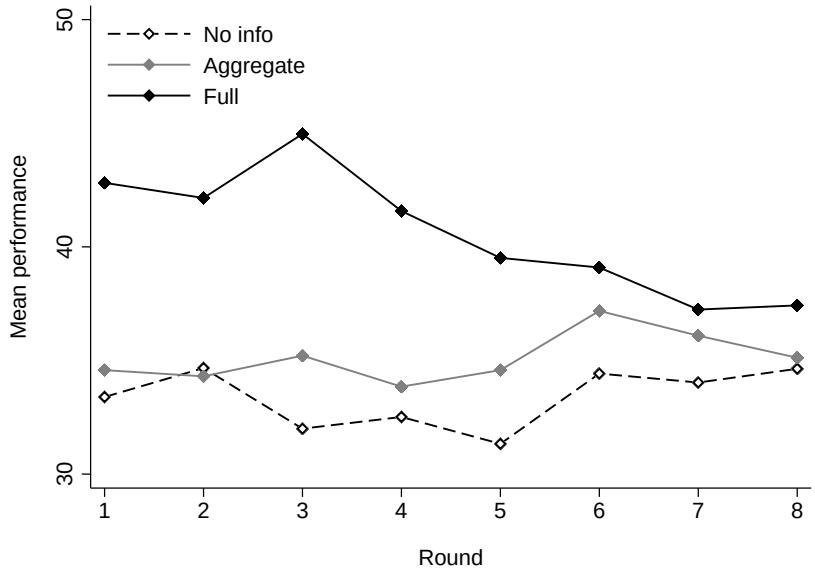
	Equity (E)	Inequity (I)
No info (N)	NE: 1×33	NI: 1×33
Aggregate (A)	AE: 3×11	AI: 3×11
Full (F)	FE: 3×11	AI: 3×11

- Three times as many subjects were assigned to each no-info group as those assigned to each other group.
- 33 subjects in each of the 6 treatments, with 33 in each no-info groups and 11 in each other group.

Outline

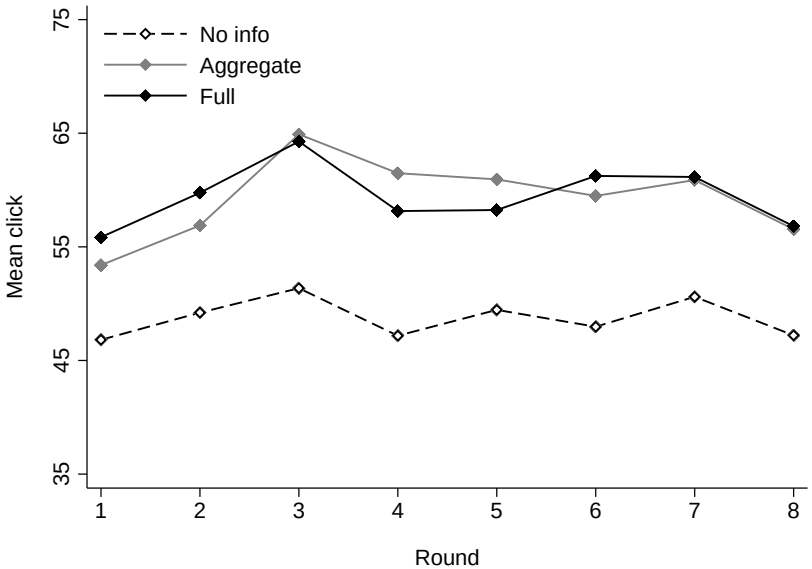


(a) Pay Equity



(b) Pay Inequity

Figure: Round-by-Round Mean Performances



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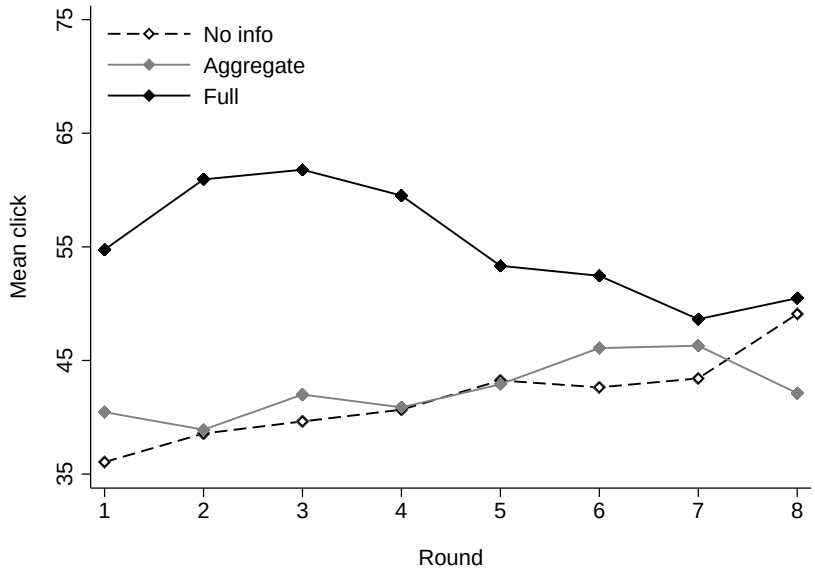


(b) Pay Inequity

Figure: Round-by-Round Mean Clicks

Table: Regressions of the treatment effects on performances

	(1) *Perf*	(2) *Perf*	(3) *Clk*	(4) *Clk*
Ineq [γ]	0.20	0.20	-9.62***	-9.62**
	(0.28)	(0.27)	(-3.18)	(-2.82)
Agg [α_1]	4.62***	4.62***	7.81**	7.81*
	(3.99)	(11.94)	(2.55)	(5.23)
Full [α_2]	5.54***	5.54***	5.78**	5.78
	(5.31)	(12.77)	(2.02)	(4.15)
Ineq × *Agg* [δ_1]	-3.25**	-3.25**	-5.75	-11.85**
	(-2.43)	(-5.66)	(-1.29)	(-5.63)
Ineq × *Full* [δ_2]	1.14	1.14	13.40***	13.40**
	(0.71)	(1.80)	(2.72)	(6.48)
Linear tests				
Policy effects under Pay Equity (E):				
AE - NE [α_1]	4.62***	4.62***	7.81**	7.81**
	(3.99)	(11.94)	(2.55)	(5.23)
FE - NE [α_2]	5.54***	5.54***	5.78***	5.78***
	(5.31)	(12.77)	(2.02)	(4.15)
Policy effects under Pay Inequity (I):				
AI - NI [$\alpha_1 + \delta_1$]	1.37**	1.37	2.06	-4.05
	(2.12)	(3.53)	(0.63)	(-2.75)
FI - NI [$\alpha_2 + \delta_2$]	6.68***	6.68***	19.18***	19.18***
	(5.72)	(15.06)	(4.71)	(11.83)
Diff. btw. Policies (A) and (F):				
FE - AE [$\alpha_2 - \alpha_1$]	0.92	0.92	-2.03	-2.03
	(0.63)	(3.40)	(-0.54)	(-2.27)
FI - AI [$\alpha_2 + \delta_2 - \alpha_1 - \delta_1$]	5.31***	5.31**	17.13***	23.23*
	(4.40)	(20.40)	(3.45)	(16.04)
Controls	Yes	Yes	Yes	Yes
# of clusters	198	78	198	78
Obs.	1584	1584	1584	1584
R-squared	0.37	0.37	0.32	0.32

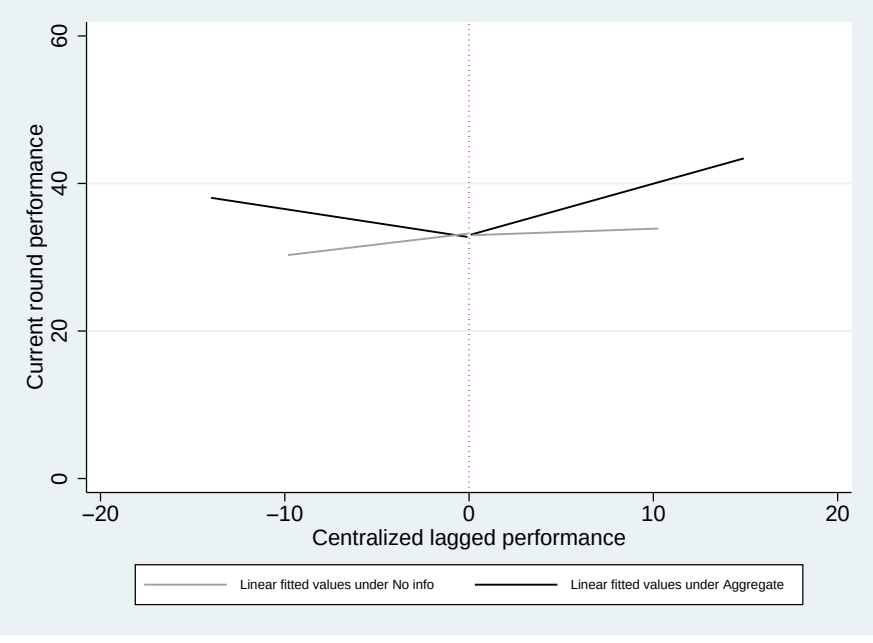
Result 1

In general, pay transparency can motivate subjects to exert more physical effort and improve their performances.

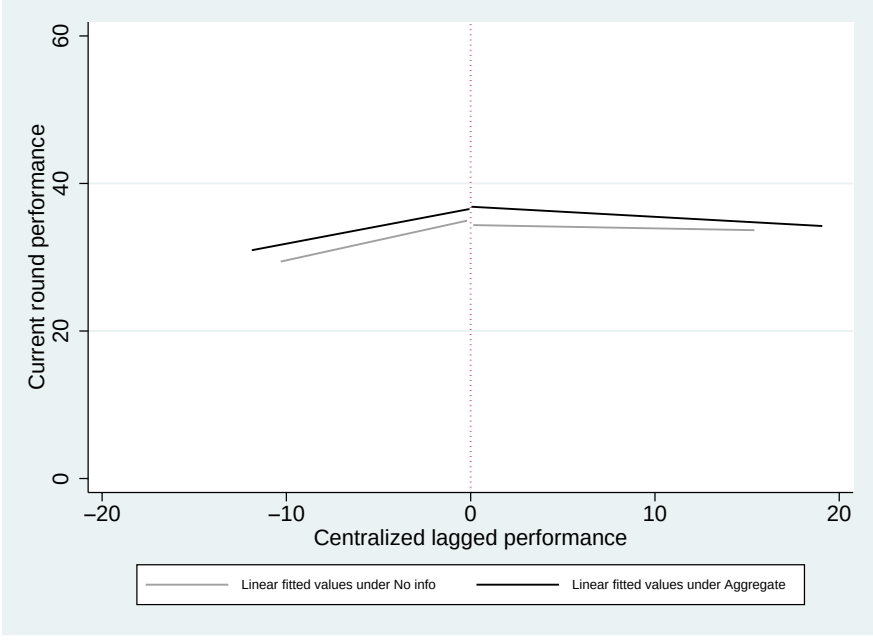
Result 2

The full and the aggregate information policies have similar effects on subjects' physical effort and performances under Pay Equity, but the effects are significantly different under Pay Equity.

The Aggregate information policy



(a) Under Pay Equity (E)



(b) Under Pay Inequity (I)

The Aggregate information policy

Table: Social comparison under pay equity: Policy (A)

	(1) *d.Perf*	(2) *d.Perf*
Agg	0.12	17.61**
	(0.23)	(3.62)
L.High	-6.02***	4.01
	(-10.74)	(0.53)
Agg × *L.High*	0.84	-24.27**
	(1.15)	(-3.07)
L.Pay		-0.81***
		(-6.05)
Agg × *L.Pay*		-0.44**
		(-2.91)
L.High × *L.Pay*		-0.15
		(-0.68)
Agg × *L.High* × *L.Pay*		0.75**
		(3.38)
Linear tests		
Relative *L.Pay* when *L.High* = 0		-0.44**
		(-2.91)
Relative *L.Pay* when *L.High* = 1		0.31
		(1.45)
Controls	Yes	Yes
Perf0	Yes	Yes
# of clusters	36	36
Obs.	462	462
R-squared	0.28	0.51

The Aggregate information policy

Result 3

Under the Aggregate information policy (A) with Pay Equity, for subjects being paid below the group average in the previous round, their current round performances decrease with their previous round pay. However, those subjects being paid above the group average in the previous round do not change their performance significantly in the current round

The Full information policy

The random variation in the allocation of rank within a tie allow us to side step the potential confounds arising from serially dependent unobservables. Formally we define a "*tie*" as follows:

- For round 1, a tie is a set of subjects (of cardinality greater than one) from the same treatment that all perform the same.
- In rounds 2 to 8, a tie is a set of subjects from the same group that all perform the same in a given round.

The Full information policy

G groups, N subjects, R rounds. we estimate an equation with a fully flexible specification of the unknown rank response function:

$$Perf_{n,g,r} = \sum_{k=1}^{N} \varphi_k \mathbf{1}_{\{k\}}(Rank_{n,g,r-1}) + \eta_t + \beta X_{n,g} + \epsilon_{n,g,r} \text{ for } (n,g,r) \in \Im$$

where $Rank_{n,g,r-1} \in \{1, ..., N\}$ denotes the previous round; $\mathbf{1}(Rank_{n,g,r-1})$ takes the value one if $Rank_{n,g,r-1} = k$. η_t for $t = 1, ..., T$ are the fixed effects for tie; $X_{n,s}$ denotes observed subject-specific characteristics.

The Full information policy

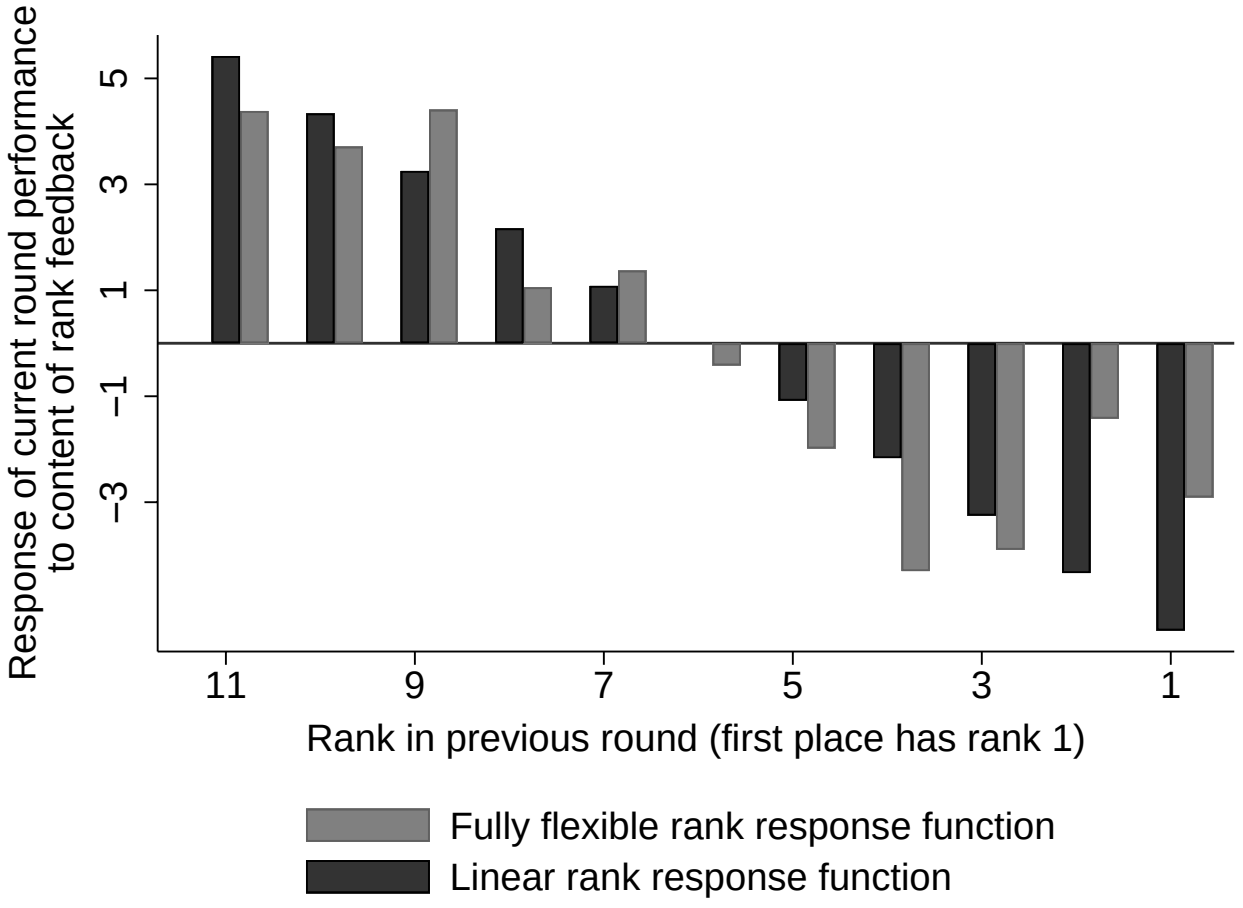


Figure: The rank response function for treatment (FE)

The Full information policy (F)

Table: Social comparison under pay inequity: Policy (F)

	(1) *Perf*	(2) *d.Perf*
L.Rank	1.04***	-0.97***
	(3.48)	(-8.98)
Full		-11.19***
		(-11.52)
Full × *L.Rank*		1.87***
		(14.72)
Controls	Yes	Yes
Perf0	Yes	Yes
# of clusters	55	36
Obs.	128	462
R-squared	0.36	0.34

The Full information policy (F)

Result 4

Under the Full information policy (F) under Equity condition, subjects who rank low in the previous round improve their performance in the current round. However, those subjects who rank high in the previous round do not perform significantly better in the current round.

Results 3 and 4 both suggest that under Pay Equity, subjects exhibit strong aversion for being behind in either Policy (A) or (F), but the preference for being ahead is negligible.

The Aggregate information policy

Table: Social comparison under pay inequity: Policy (A)

	(1) *d.Perf*	(2) *d.Perf*	(3) *d.Perf*
Agg	-0.67	0.01	-1.24
	(-2.19)	(0.00)	(-0.27)
L.High	-3.19***	-14.10*	9.23
	(-5.79)	(-1.70)	(0.78)
Agg × *L.High*	0.28	-6.22	-9.62
	(0.50)	(-0.65)	(-0.62)
L.Pay		-0.67***	-0.83***
		(-4.54)	(-6.89)
Agg × *L.Pay*		0.02	0.05
		(0.10)	(0.33)
L.High × *L.Pay*		0.41*	-0.27
		(1.81)	(-0.86)
Agg × *L.High* × *L.Pay*		0.14	0.28
		(0.53)	(0.72)
Agg × *Hp* × *L.Pay*			-4.32
			(-7.97)
Agg × *L.High* × *Hp* × *L.Pay*			3.95
			(5.74)
Linear tests			
Relative *L.Pay* when *L.High* = 0		0.02	
		(0.10)	
for *Hp* = 0			0.05
			(0.33)
for *Hp* = 1			-4.28
			(-9.65)
Relative *L.Pay* when *L.High* = 1		-0.06	
		(-0.40)	
for *Hp* = 0			0.33
			(0.93)
for *Hp* = 1			-0.04
			(-0.28)
Controls	Yes	Yes	Yes
Perf0	Yes	Yes	Yes
# of clusters	36	36	36
Obs.	462	462	462
R-squared	0.28	0.51	0.47

The Aggregate information policy (A)

Result 5

Under the Aggregate information policy (A) with Pay Inequity (I), subjects exhibit no significant tendency of either behind aversion or ahead seekings.

The Full information policy

Table: Social comparison under pay inequity: Policy (F)

	(1) *d.Perf*	(2) *d.Perf*
Full	-10.34***	-15.95***
	(-10.71)	(-12.53)
L.Rank	-0.86***	-0.82***
	(-11.51)	(-8.47)
Full × *L.Rank*	1.51***	2.00***
	(15.99)	(16.60)
Hp		3.03**
		(2.67)
Full × *Hp*		3.82**
		(3.17)
Hp × *L.Rank*		-0.26**
		(-2.21)
Full × *Hp* × *L.Pay*		-.05
		(-0.23)
Linear tests		
Relative coefficient of *L.Rank*		
for $Hp = 0$		2.00***
		(16.99)
for $Hp = 1$		1.95***
		(10.34)
Controls	Yes	Yes
Perf0	Yes	Yes
# of clusters	36	36
Obs.	462	462
R-squared	0.24	0.30

The Full information policy (F)

Result 6

Under the Full information policy (F) with Pay Inequity, for subjects receiving either low or high piece-rate, they significantly improve their performance if they receive lower rank in previous round.

- Results 5 and 6 suggest that the patterns of social comparison are different between Policies (A) and (F) under pay inequity, and the tendency is weaker in Policy (A) than in Policy (F).

Outline

Conclusion

- Both partial and full pay transparency policies can entice individuals to increase their effort and improve their performances regardless of the fairness of the payment scheme.
- However, the comparison between the effects of the pay transparency policies (A) and (F) are different under different payment scheme:
  - Under the fair payment scheme, we find no significant difference in performance between partial and full pay transparency.
    - We observe a strong presence of behind aversion under both pay transparency policies, whereas the ahead seeking behavior has not been found.
  - Under the unfair payment scheme, the full pay transparency improves the performances significantly more than the partial transparency.
    - The social comparison effects are much less consistent under pay inequity.

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Conclusion

- Our study also provides interesting perspectives for future research.
  - While we focus on the influence on output side, more can be done to explore its influence on firm's side;
  - literature remains scant on the effect of partial transparency on workplace inequality.

Step 1: randomly assign subjects in FN and PN into 3 groups respectively.

Step 2: calculate the group average performance.

Step 3: regress subjects' performances and record the point estimate and standard error of the coefficients.

Step 4: repeat Steps 1 to 3 1000 times, and calculate the frequencies of the point estimates being insignificant ($p - value > 0.1$).