Stylized Fact: Wage Compression

- Prevalent in poor and rich countries (Dreze & Mukherjee 1989, Frank 1984)
- Many potential explanations
- One potential reason: relative pay comparisons

Source: Breza, Kaur, Krishnaswamy, & Shamdasani (ongoing).
Sample size: 377 worker-days, 83 workers, 26 villages.
Research Questions

• Do workers care about relative pay?
  – Labor supply
  – Effort (under incomplete contracting)

• When are pay differences acceptable?
  – Worker beliefs about justifications

• Use field experiment with manufacturing workers
  – Vary own and peer wages
Motivation: Relative Pay Concerns

- Long tradition of thought in social sciences
  - Psychology, sociology, management (e.g. Adams 1963)
  - Economics (e.g. Marshall 1890, Hicks 1932, Hamermesh 1975)

- Potential Implications
  - Wage compression (e.g. Fang & Moscarini 2006, Charness & Kuhn 2007)
  - Wage rigidity (e.g. Akerlof & Yellen 1990, Bewley 1999)
  - Sorting of workers into firms (e.g. Frank 1984)
  - Firm boundaries (e.g. Nickerson & Zenger 2008)
  - HR policies (e.g. Bewley 1999, Card et al. 2012)
  - Features of production (e.g. output observability) could affect when these effects manifest themselves (e.g. Bracha et al. 2015)
Limited field evidence on relative pay comparisons

• Mixed lab evidence
  – Charness & Kuhn 2007, Gachter & Thoni 2010, Bartling and von Siemens 2011, Bracha et al. 2015,…

• 2 recent field experiments focused on relative pay
  – Card, Mas, Moretti, & Saez (AER 2012)
  – Cohn, Fehr, Herrmann, & Schneider (JEEA 2014)
Outline

• (Brief) Framework

• Experiment Design

• Results

• Discussion
Framework (adapted from DellaVigna et al 2015)

Worker $i$ receives wage offer $w_i$ from firm, and chooses:
(i) whether to work
(ii) level of effort (incomplete contracting).

Outside option (from not working): $R_{it} \equiv R_i + \varepsilon_{it}$

Payoff from working:

$$V (w_i, w_{-i}) = w_i - c \left( e_i \right) + M \left( w_i, w_{-i} \right) e_i$$

where:

$e_i =$ effort level chosen, where $e_i \geq 0$

$c(\cdot) =$ convex effort cost

$w_{-i} =$ wages of co-workers (peers)

$M \left( w_i, w_{-i} \right) =$ morale effect
Framework

Conceptualize relative pay concerns as reference dependence

\[ V(w_i, w_{-i}) = w_i - c(e_i) + M(w_i, w_{-i})e_i \]

\[ M(w_i, w_{-i}) = \alpha 1_{w_i < w_R(w_{-i})} + \beta 1_{w_i > w_R(w_{-i})} + f(w_i) \]

where:
- \( w_R(w_{-i}) \) is the reference wage
- \( \alpha \) reflects utility effect of being paid less than \( w_R \)
- \( \beta \) reflects utility effect of being paid more than \( w_R \)
Framework

Conceptualize relative pay concerns as reference dependence

\[ V(w_i, w_{-i}) = w_i - c(e_i) + M(w_i, w_{-i})e_i \]

\[ M(w_i, w_{-i}) = \alpha 1_{w_i < w_R(w_{-i})} + \beta 1_{w_i > w_R(w_{-i})} + f(w_i) \]

where:
- \( w_R(w_{-i}) \) is the reference wage
- \( \alpha \) reflects utility effect of being paid less than \( w_R \)
- \( \beta \) reflects utility effect of being paid more than \( w_R \)

Testing for morale effects

- Changes in \( 1_{w_i < w_R} \) and \( 1_{w_i > w_R} \) will affect both labor supply & effort
- Direction of effects reveal signs of \( \alpha \) and \( \beta \)
  - E.g., Under loss aversion: \( \alpha < 0, \beta \geq 0, |\alpha| > |\beta| \)
- No ex-ante stance on functional form of \( w_R(w_{-i}) \)
Outline

• (Brief) Framework

• Experiment Design

• Results

• Discussion
Context

• Low-skill manufacturing
  – Rope, brooms, incense sticks, candle wicks, plates, floor mats, paper bags…
  – Factory sites in Orissa, India
  – Partner with local contractors (set training and quality standards)
  – Output sold in local wholesale market

• Workers employed full-time over one month
  – Seasonal contract jobs (common during agri lean seasons)
  – Primary source of earnings

• Flat daily wage for attendance
  – Typical pay structure in area

• Sample (for today)
  – 378 workers
  – Adult males, ages 18-65
Experiment Design

Construct design to accomplish 3 goals:

1. Clear reference group for each worker

2. Variation in co-worker pay, holding fixed own pay

3. Variation in perceived justification for pay differences
1. Reference Group = Product Team

- Teams of 3 workers each

- All team members produce same product

- Each team within factory produces different product
  - E.g. Team 1 makes brooms, Team 2 makes incense sticks, …

- Factory structure
  - 10 teams in each factory
  - 10 products: brooms, incense sticks, rope, wicks, plates, etc.

- Note: Individual production
  - Hire staff to measure worker output after each day
Experiment Design

Construct design to accomplish 3 goals:

1. Clear reference group for each worker

2. Variation in co-worker pay, holding fixed own pay

3. Variation in perceived justification for pay differences
Wage Treatments

Design: Wage Treatments

<table>
<thead>
<tr>
<th>Worker Rank</th>
<th>Heterogeneous</th>
<th>Compressed_L</th>
<th>Compressed_M</th>
<th>Compressed_H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low productivity</td>
<td>$w_{\text{Low}}$</td>
<td>$w_{\text{Low}}$</td>
<td>$w_{\text{Medium}}$</td>
<td>$w_{\text{High}}$</td>
</tr>
<tr>
<td>Medium productivity</td>
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<td>$w_{\text{High}}$</td>
</tr>
</tbody>
</table>

- Rank computed from baseline productivity
- Modest wage differences: $w_{\text{High}} - w_{\text{Low}} \leq 10\%$
### Design: Wage Treatments

<table>
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</table>

- Expect $w_i < w_R(w_i)$

- Predictions
  - $H_0$: $\alpha = 0$: same output
  - $H_1$: $\alpha < 0$: output lower under Heterogeneous pay
## Wage Treatments

### Design: Wage Treatments

<table>
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<tr>
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</tr>
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</table>

- Expect $w_i > w_R (w_i)$

- Predictions
  - $H_0$: $\beta = 0$: no difference in output
  - $H_1$: $\beta \geq 0$: output weakly higher under Heterogeneous
### Wage Treatments

#### Design: Wage Treatments

<table>
<thead>
<tr>
<th>Worker Rank</th>
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</table>

- No ex-ante prediction on $w_i$ relative to $w_R(w_{-i})$
- Use findings to gain better understanding of $w_R(w_{-i})$
Experiment Design

Construct design to accomplish 3 goals:

1. Clear reference group for each worker

2. Variation in co-worker pay, holding fixed own pay

3. Variation in perceived justification for pay differences
   – 2 tests
### Justifications I: “Actual” Fairness

<table>
<thead>
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<th>Worker Rank</th>
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</table>

- Productivity is continuous
- Discrete fixed differences in wages

→ Variation in \( \Delta \text{Wage} / \Delta \text{Productivity} \) among co-workers
### Justifications II: Perceived Fairness

<table>
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- 10 production tasks
- **Differ in observability of co-worker output**
  - Quantify task observability at baseline
- **Stratify treatment assignment by task (across rounds)**
• 30 workers (10 teams) per round
• At entry – workers randomly assigned to team & product
• Training: all workers receive same training wage
• On day 1: workers are told their post-training wage may depend on baseline productivity
Timeline for Each Round

- Recruitment
- “Training” period (baseline output)
- Job begins
- Output is sellable
- Feedback on rank
- Teams randomized into wage treatments

- Each worker privately told his individual wage
- Managers maintain pay secrecy
Timeline for Each Round

Recruitment

1

“Training” period (baseline output)

4

10

14

Teams randomized into wage treatments
(Managers maintain pay secrecy)

Day

Output is sellable

Feedback on rank

Job begins

Endline survey

35
Summary of Randomization

Randomize workers into teams of 3

Variation in relative productivity within teams (Actual fairness)

Randomize teams into tasks

Variation in observability of co-worker output (Perceived fairness)

Randomize into wage treatments (stratify by task)

Workers of heterogeneous ability
2 Caveats

- Purposefully shutting off dynamic incentives
- Goal is to test for relative pay concerns – not a statement about optimal pay structure
Outline

• (Brief) Framework

• Experiment Design

• Results
  – Wage treatments
  – Perceived justifications
  – Team cohesion (endline games)

• Discussion
Did workers learn co-worker wages?

- Use endline survey to verify knowledge of co-worker wages

- Compressed teams
  - 100% state that fellow teammates have the same wage

- Heterogeneous teams
  - 92% state that teammates have different wages from them
  - 77% can accurately report the 2 teammates’ wages
  - No systematic pattern in lack of knowledge
Measurement

• Production = 0 when workers are absent

• Pooling across tasks
  – 10 production tasks
  – Standardize output within each task (using mean and standard deviation in baseline period)
### Effects of Relative Pay Differences

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Recall:

- Expect $w_i < w_R(w_i)$

![Graph showing standardized production residual over days for low rank workers. The x-axis represents days from -10 to 20, and the y-axis represents standardized production residual from -5 to 5. The graph includes two lines: one for 'Compressed_L pay' and another for 'Heterogeneous pay'.](image)
## Effects of Relative Pay Differences

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Recall:

- Expect $w_i < w_R (w_{-i})$
- Consistent with $\alpha < 0$
## Effects of Relative Pay Differences

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Recall:

- Expect $w_i > w_R(w_{-i})$
- Little evidence for $\beta > 0$
- Consistent with loss aversion

![Graph showing standardized production residual over days](image)
### Effects of Relative Pay Differences

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</table>

- No evidence for fairness violation

![Graph showing Medium Rank Workers](image)

**x-axis**: Day  
**y-axis**: Standardized production residual

- Compressed_M pay
- Heterogeneous pay
## Effects of Relative Pay Differences

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Output (standard dev.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full sample (1)</td>
</tr>
</tbody>
</table>

- **Post x Heterogeneous**:  
  - (1): -0.372*** (0.119)  
  - (2): -0.311** (0.125)  
  - (3): -0.316** (0.127)

- **Post x Heterogeneous x Med rank**:  
  - (1): 0.360** (0.164)  
  - (2): 0.327** (0.177)*  
  - (3): 0.389** (0.174)

- **Post x Heterogeneous x High rank**:  
  - (1): 0.207 (0.216)  
  - (2): 0.238 (0.211)  
  - (3): 0.260 (0.220)

- **Production task fixed effects?**  
  - Yes  
  - No

- **Individual fixed effects?**  
  - No
  - Yes
  - Yes

- **F-test pvalue: (Post x Het) + (Post x Het x Med) = 0**:  
  - (1): 0.465  
  - (2): 0.392  
  - (3): 0.252

- **F-test pvalue: (Post x Het) + (Post x Het x High) = 0**:  
  - (1): 0.405  
  - (2): 0.693  
  - (3): 0.760

- **Post-treatment Compressed Mean**:  
  - -0.0266  
  - -0.0266  
  - -0.0460

- **R-squared**:  
  - 0.252  
  - 0.187  
  - 0.194

- **N**:  
  - 7755  
  - 7755  
  - 6169

**Notes**: Regressions include day*round fixed effects and controls for neighboring teams. Standard errors clustered by team.

- Lower paid workers: 29% reduction in output
## Effects of Relative Pay Differences

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable:</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output (standard dev.)</td>
<td></td>
<td>Attendance</td>
</tr>
<tr>
<td></td>
<td>Full sample</td>
<td>Full sample</td>
<td>Non-paydays</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
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<td>Post x Heterogeneous</td>
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**Production task fixed effects?** Yes No No No No
**Individual fixed effects?** Yes No No Yes Yes

F-test p-value: (Post x Het) + (Post x Het x Med) = 0 0.465 0.392 0.252 0.356 0.277
F-test p-value: (Post x Het) + (Post x Het x High) = 0 0.405 0.693 0.760 0.0499 0.0581

Post-treatment Compressed Mean -0.0266 -0.0266 -0.0460 0.928 0.917
R-squared 0.252 0.187 0.194 0.198 0.209
N 7755 7755 6169 7755 6169

**Notes:** Regressions include day*round fixed effects and controls for neighboring teams. Standard errors clustered by team.

- Lower paid workers: leave 9% of earnings on the table
- Back of envelope: Attendance accounts for 50% of total output effect
- See output decline when limiting analysis to paydays only
Outline

• (Brief) Framework

• Experiment Design

• Results
  – Effects of wage differences
  – Perceived justifications: 2 tests
  – Team cohesion (endline games)

• Discussion
Perceived Justifications: Productivity Differences

• Difference in pre-period output between yourself and your higher-paid peer (for L and M rank)

• Indicator for being above mean difference
  – Corresponds to 0.32 standard deviations
  – Robust to other cut-offs and also continuous measure
## Perceived Justifications: Productivity Differences

<table>
<thead>
<tr>
<th>Dependent variable:</th>
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<th>Attendance (standard dev.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Post x Heterogeneous</td>
<td>-0.548***</td>
<td>-0.213***</td>
</tr>
<tr>
<td></td>
<td>(0.196)</td>
<td>(0.0651)</td>
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<tr>
<td>Post x Heterogeneous x High prod difference</td>
<td>0.634**</td>
<td>0.289***</td>
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<tr>
<td></td>
<td>(0.273)</td>
<td>(0.0858)</td>
</tr>
<tr>
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<td>0.203***</td>
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<tr>
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<td>(0.221)</td>
<td>(0.0755)</td>
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<tr>
<td>Post x Heterogeneous x Med rank x High prod difference</td>
<td>-1.105***</td>
<td>-0.347***</td>
</tr>
<tr>
<td></td>
<td>(0.388)</td>
<td>(0.123)</td>
</tr>
<tr>
<td>Post x Heterogeneous x High rank</td>
<td>0.475*</td>
<td>0.110</td>
</tr>
<tr>
<td></td>
<td>(0.255)</td>
<td>(0.0727)</td>
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</table>

**Notes:** Regressions include individual fixed effects, day*round fixed effects, and neighboring team controls. Standard errors clustered by team.

- Potential concern: High productivity difference comes from low own productivity (e.g., L rank hit floor effects)
- Use 2 robustness checks to test (Cols. 2-3)
Perceived Justifications: Observability

- 10 production tasks in each worksite
- Ex-ante quantify observability at baseline (using pilots)
  - All teammates paid the same wage (no signal)
  - Can worker accurately state own productivity relative to peers?
### Perceived Justifications: Observability

#### Dependent variable:

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Output (standard dev.)</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post x Heterogeneous</td>
<td>-0.840*** (0.234)</td>
<td>-0.120 (0.081)</td>
</tr>
<tr>
<td>Post x Heterogeneous x Observability correlation</td>
<td>1.205*** (0.414)</td>
<td>0.0910 (0.117)</td>
</tr>
<tr>
<td>Post x Heterogeneous x Med rank</td>
<td>0.726** (0.346)</td>
<td>0.131 (0.107)</td>
</tr>
<tr>
<td>Post x Heterogeneous x Med rank x Observability correlation</td>
<td>-1.006* (0.621)</td>
<td>-0.212 (0.195)</td>
</tr>
<tr>
<td>Post x Heterogeneous x High rank</td>
<td>0.552* (0.318)</td>
<td>-0.00875 (0.095)</td>
</tr>
<tr>
<td>Post x Heterogeneous x High rank x Observability correlation</td>
<td>-0.851 (0.551)</td>
<td>-0.0596 (0.139)</td>
</tr>
</tbody>
</table>

**Number of observations (worker-days)**: 7755

**Notes**: Regressions include individual fixed effects, day*round fixed effects, and neighboring team controls. Standard errors clustered by team.
Effects on Compressed Teams

• Compressed team members: all paid same wage within team

• Variation in relative productivity at baseline has no effect on subsequent performance

• Indicates fairness violation only triggered when pay levels differ
Outline

• (Brief) Framework

• Experiment Design

• Results
  – Wage treatments
  – Perceived justifications
  – Team cohesion (endline games)

• Discussion
Tests for Team Cohesion

• Cooperative games on last day (fun farewell)
  – Performance determined by your own effort and cooperation with partner

• Paid piece rates for performance

• No benefit to the firm
  – Decrease in Heterogenous team performance is not about punishing the firm

• Note: conducted in later rounds only
Cooperative pair games

- Spot the difference & Symbol matching
- Workers in pairs: each gets 1 sheet, must cooperate to solve
Games 2: Cooperative pair games

- Reshuffle workers into pairs

- Variation in whether paired with own teammate or person from another team

- One common pairwise score for each pair-game
  - Item must be correct and circled by both individuals in pair

- More explicit test for team cohesion: Examine how Heterogeneous workers perform with own teammates vs. others
### Games 2: Cooperative pair games

**Dependent variable: Number of items correct**

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both workers from same team</td>
<td>0.440</td>
<td>0.287</td>
<td><strong>0.613</strong></td>
</tr>
<tr>
<td></td>
<td>(0.290)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both workers from same team x Heterogeneous</td>
<td>-0.929**</td>
<td>0.464</td>
<td>-0.888*</td>
</tr>
<tr>
<td></td>
<td>(0.465)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least one Heterogeneous worker in pair</td>
<td>0.411</td>
<td>0.345</td>
<td>0.383</td>
</tr>
<tr>
<td></td>
<td>(0.334)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least one low rank worker in pair</td>
<td>-0.820***</td>
<td>0.269</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.291)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least one medium rank worker in pair</td>
<td>-0.599**</td>
<td>0.281</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.278)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Observations:** Number of pair-games 1,870

**Dependent variable mean** 4.329

**R-squared** 0.199

- **Compressed teams:** benefits of playing with teammate
- **Heterogeneous team:** benefit is completely undone (like playing with a stranger)
- (Note predictive power of productivity rankings in games)
Outline

• (Brief) Framework

• Experiment Design

• Results

• Discussion
Alternate Explanations?

• Career concerns
  Workers take relative wage as signal of \Pr(\text{future employment})
  – Workers are told this is a one-time job
  – Inconsistent with attendance effect (why give up full-time earnings)
  – Inconsistent with the observability and relative difference results

• Discouragement effects / self-signaling
  Workers interpret lower wage as negative signal about productivity and reduce output due to discouragement
  – No negative effect of telling workers their own ranks
  – Inconsistent with the observability and relative difference results
Dynamic incentives

• Lack of dynamic incentives
  Experiment shuts down possibility of earning higher wage after treatment
  – We are isolating one mechanism: morale effect of unequal pay.
  – Unequal pay may have other benefits (e.g. motivation or selection). Optimal policy would balance these effects.
  – Not uncommon to have wage set based on $E[MPL]$, with strong persistence
Conclusion

Summary

• Effort and earnings reductions for L rank, no benefits for H rank
• Perceived justifications are very important

Some possible implications

• Wage compression may be more likely in some settings than others
  – Performance pay perceived as fair (piece rates) → wage dispersion in salaried sales agents
  – Flat wages are often severely compressed (prevailing daily wage) → wage compression in flat hourly or daily wage workers

• Effects of increased transparency in effort
  – Output increases beyond traditional moral hazard benefits
Conclusion

Implications for welfare?

• Wage compression common
  – Casual daily wage, mailroom clerk, tollbooth attendant

• Reward for performance through extensive margin
  – Days of employment, Pr(promotion), Pr(retention)
  – In some sense, incentives may be very high powered

• Wage compression ≠ Earnings compression
  – Compressed wage → insurance?
  – Earnings dispersion → exacerbates inequality?

• Breza, Kaur, Krishnaswamy (ongoing)
Appendix
### Team Level Regressions

<table>
<thead>
<tr>
<th></th>
<th>Production (std dev)</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Sample</td>
<td>Excluding First Day</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Post Wage Change x Heterogeneous Team</td>
<td>-0.440 (-0.409)</td>
<td>-0.0425 (-0.0320)</td>
</tr>
<tr>
<td>Post Wage Change x Compressed_Medium Team</td>
<td>0.00225 (0.483)</td>
<td>0.0317 (0.0278)</td>
</tr>
<tr>
<td>Post Wage Change x Compressed_High Team</td>
<td>0.756 (0.471)</td>
<td>0.0682** (0.0274)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excluding First Day</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full Sample</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excluding First Day</td>
</tr>
<tr>
<td>Team-day observations</td>
<td>1,483</td>
<td>1,407</td>
</tr>
</tbody>
</table>

*Notes*: Difference in differences regressions. Regressions include task*experience, day*round, and team fixed effects. Standard errors clustered by team. Compressed_Low Team is the omitted category.
## Productivity Differences

<table>
<thead>
<tr>
<th>Productivity difference measure</th>
<th>Dependent variable: Output (standard dev.)</th>
<th>Dependent variable: Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production difference</td>
<td>Above mean difference</td>
</tr>
<tr>
<td>Post x Heterogeneous</td>
<td>-0.294**</td>
<td>-0.539***</td>
</tr>
<tr>
<td></td>
<td>(0.149)</td>
<td>(0.197)</td>
</tr>
<tr>
<td>Post x Heterogeneous x Prod difference</td>
<td>0.128</td>
<td>0.604**</td>
</tr>
<tr>
<td></td>
<td>(0.223)</td>
<td>(0.277)</td>
</tr>
<tr>
<td>Post x Heterogeneous x Med rank</td>
<td>0.651**</td>
<td>0.956***</td>
</tr>
<tr>
<td></td>
<td>(0.280)</td>
<td>(0.300)</td>
</tr>
<tr>
<td>Post x Heterogeneous x Med rank x Prod difference</td>
<td>-0.634</td>
<td>-1.210***</td>
</tr>
<tr>
<td></td>
<td>(0.409)</td>
<td>(0.397)</td>
</tr>
<tr>
<td>N</td>
<td>7,755</td>
<td>7,755</td>
</tr>
</tbody>
</table>

*Notes: Regressions include individual fixed effects, day*round fixed effects, and neighboring team controls. Standard errors clustered by team.*