Financial Incentives in Multi-layered Organizations: An Experiment in the Public Sector

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July, 26 2021
NBER Development

Motivation

- Organizations are divided in multiple, hierarchical layers (Wilson 1989)

- Effort of workers in the different layers contribute to production of final output

- How should incentives be allocated across the different layers of an organization?

This Paper

- ▶ Experiment with a large public health organization in Sierra Leone, organized into teams with two layers
  - ▶ 7-10 frontline health workers
  - ▶ 1 supervisor

- ▶ In 372 teams, we introduce a new piece-rate incentive that rewards output (health visits)

- ▶ We randomize recipients of the incentive:
  1. workers only
  2. supervisors only
  3. equally shared between workers and supervisors

Preview of Results

▶ Shared incentives outperform one-sided incentives

▶ Due to 2 common features in multi-layered organizations:
  1. strong complementarity in worker and supervisor effort
  2. large contractual frictions which limit the redistribution of the incentive through side-payments

▶ Evidence rejects alternative mechanisms: aversion to pay inequality, sharp non-linearity of utility function

▶ Structural model of service provision
  ▶ estimates parameters for complementarities and frictions
  ▶ counterfactual exercises

Related Literature and Contribution

▶ Empirical literature on incentives focuses on one layer

    ▶ bottom layer (frontline workers or sales associates)
    [e.g., Lazear 2000, Glewwe et al. 2010, Muralidharan and Sundararaman
    2011, Duflo et al. 2012, Ashraf et al. 2014]

    ▶ top layer (managers/ supervisors/ CEOs)
    [e.g., Bandiera et al. 2007, Bertrand 2009, Frydman and Jenter 2010,
    Rasul and Rogger 2018, Luo et al 2019]

    ⇒ We leverage a field experiment and a structural model to
    study allocation of incentives *across* layers

▶ Literature on information problems in vertical orgs
 [Tirole 1986, Tirole et al. 1991, Dodge et al. 2018, Bandiera et al. 2020, Callen
et al. 2020, Dal Bó et al. 2020, Muralidharan et al. 2021]

    ⇒ We focus on a setting where the top layer does not only
    monitor, but also trains and enables the bottom layer

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The Community Health Program in Sierra Leone

- ▶ Created by the Ministry of Health to increase access to health services in rural villages

- ▶ Organized into Peripheral Health Units (PHUs), each composed of 7-10 health workers and 1 supervisor

- ▶ Health workers provide health services through households visits
  - ▶ pre and post-natal checks, accompany women to deliver in clinic, provide information about infant health

- ▶ Supervisors train and advise health workers
  - ▶ general training and in-the-field supervision

- ▶ Complementarity: success of the program requires both worker and supervisor effort

Experimental Design: New Incentive Scheme

▶ Fixed monthly pay of \$17 (SLL 150k) for health workers and \$29 (SLL 250k) for supervisors

▶ New incentive scheme that pays \$0.25 (SLL 2k) per household visit

  ▶ Worker incentives treatment (93 PHUs): incentive paid entirely to health worker

  ▶ Supervisor incentives treatment (93 PHUs): incentive paid entirely to supervisor

  ▶ Shared incentives treatment (93 PHUs): incentive equally shared between health worker and supervisor

  ▶ Control group (93 PHUs): no incentive

Incentives Structure

- Incentives are paid every month by a reputable external organization, based on a reporting system
  - SMS sent to toll-free number indicating date, service type, contact of patient

- Over-reporting and collusion limited through frequent patient back-checks
  - limited role for collusion [Tirole 1986, Tirole et al. 1991, Dodge et al. 2018, Cilliers et al. 2018, Bandiera et al. 2020]

- Supervisors transfer incentives to workers at their discretion
  - yet, few side-payments observed
  - in line with contractual frictions: e.g., poor observability of effort/output, difficulty of making binding commitments

Data and Timeline

1. Staff surveys: May 2018 (baseline) & Sept. 2019 (endline)
   - ▶ sample: 372 supervisors and 2,970 health workers
   - ▶ measure side-payments, quantity/quality of supervision

2. Household surveys: Sept. 2019 (endline)
   - ▶ sample: 8,910 households (random 3 per village)
   - ▶ measure quantity/quality of visits from health workers

3. Admin data: SMS reports and clinic services

▸ Sum Stats and Balance Checks

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A Simple Model of Service Provision

- ▶ A worker and a supervisor jointly produce output (visits) y
  - ▶ the supervisor chooses effort e_s and offers to pay the worker k for each visit (at a cost zk due to frictions)
  - ▶ the worker observes e_s and k, and chooses effort e_w
- ▶ Efforts are strategic complements: $y = \alpha e_w + \gamma e_w e_s$
- ▶ Both agents are paid an incentive based on visits
- ▶ Organization chooses the share of the incentive assigned to the worker ($p \in [0, 1]$) to maximize output

Complementarities and Frictions Determine the Optimal Contract

- ▶ Due to contracting frictions (z), the supervisor redistributes the incentive imperfectly

- ▶ Due to the complementarity (γ), effort does not always increase with the size of the incentive

- ▶ Optimal contract p^* is a function of these key parameters: effort complementarity (γ) and contractual frictions (z)
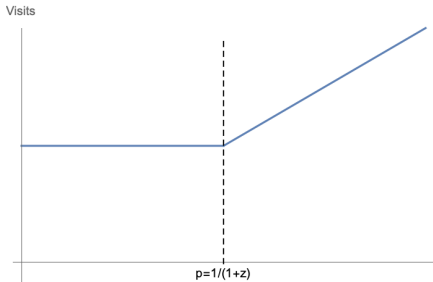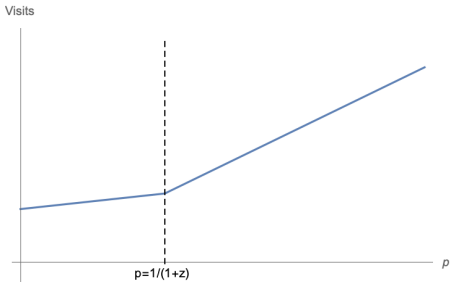
No Effort Complementarity + No Frictions ($\gamma=0$, $z=1$)

Visits

$p=1/(1+z)$

p

Effort Complementarity + No Frictions ($\gamma>0$, $z=1$)

Visits

$p=1/(1+z)$

p

No Effort Complementarity + Frictions ($\gamma=0$, $z>1$)

Visits

$p=1/(1+z)$

p

Effort Complementarity + Frictions ($\gamma>0$, $z>1$)

Visits

$p=1/(1+z)$

p
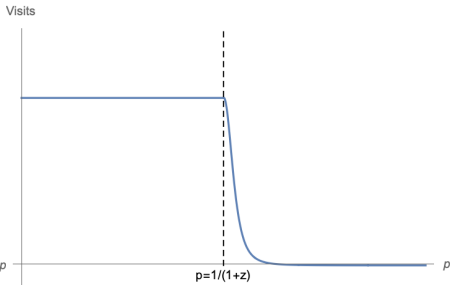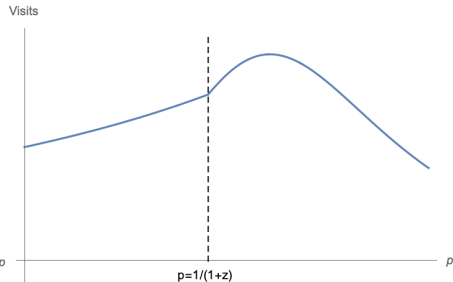
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Shared Incentives Maximize Number of Visits
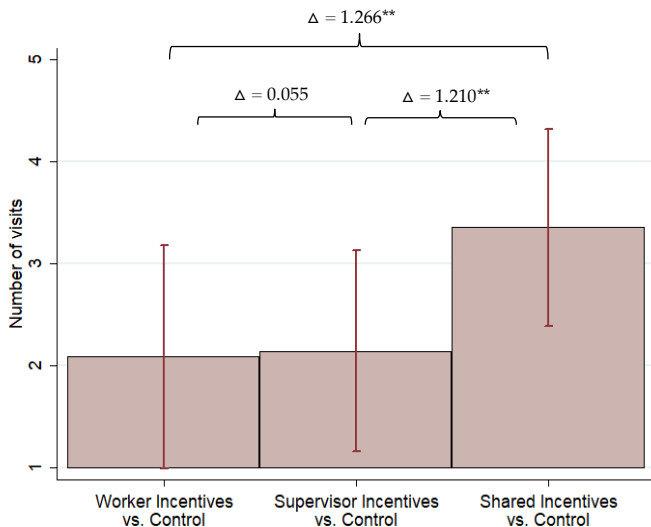
Notes: Mean in the control group = 5.334.
*** p<0.01, ** p<0.05, * p<0.1

▸ Table

Shared Incentives Maximize Quality of Visits and Trust

▶ With shared incentives, households also report:

1. longer visits, more topics discussed ▸ Table
2. more trust in the health worker ▸ Table
3. no differential targeting ▸ Table

Shared Incentives Maximize Pre- and Post-Natal Care

Source: Households Surveys

Source: Clinics Admin Data
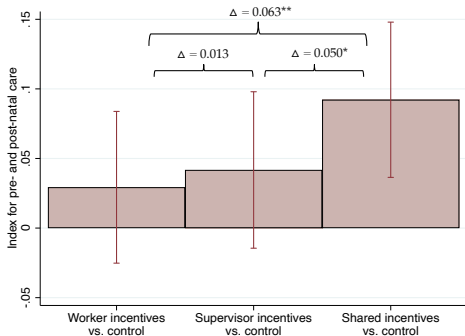
Notes: Mean in the control group = -0.048.
Index is an equally weighted average of the z-scores of 5 variables: % women who received at least 4 ante-natal visits, an institutional birth, a post-natal visit within 2 days of birth, at least 6 months of breastfeeding, up-to-date infant vaccination.
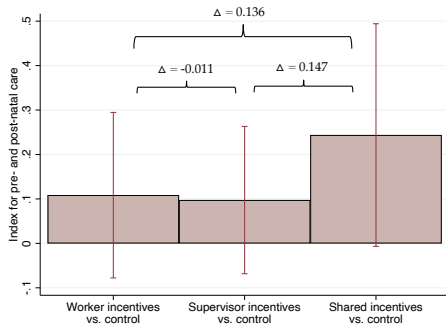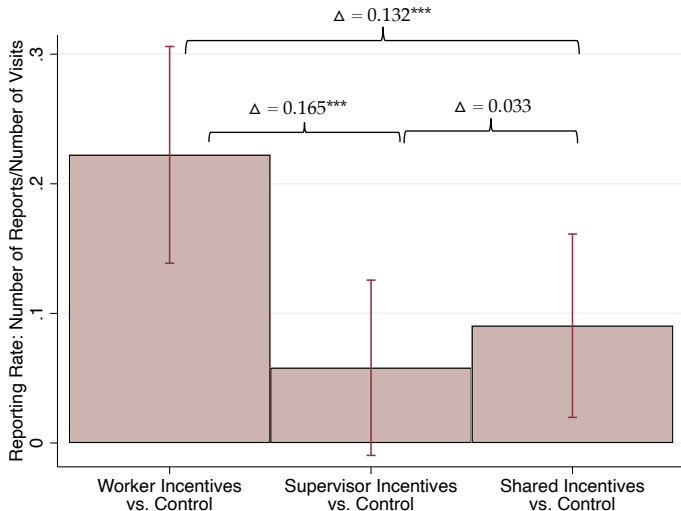
Notes: Mean in the control group = -0.110.
Index is an equally weighted average of the z-scores of 3 variables: # pregnant women services, institutional births, fully immunized infants at the clinic.

▶ Table

Cost-Effectiveness

- In terms of output: shared incentives > one-sided incentives

- But which treatment is most cost-effective?

- Recall: payments are based on SMS reports

Reporting Rate

Notes: Mean in the control group = 0.078
*** p<0.01, ** p<0.05, * p<0.1

Table

Cost-Effectiveness

▶ Worker incentives cost twice as much as supervisor incentives but achieve same output

⇒ supervisor incentives > worker incentives

▶ Shared incentives achieve twice as much output as supervisor incentives but cost nearly the same

⇒ shared incentives > supervisor incentives

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# Mechanisms

- ▶ Why are shared incentives so effective?

Mechanisms

- ▶ Why are shared incentives so effective?

- ▶ Model suggests that shared incentives maximize output when there are both effort complementarity and contractual frictions

- ▶ We provide empirical evidence on both of these

1. Effort Complementarities

Supervisor Effort

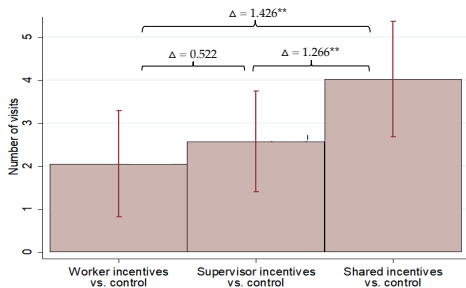► Supervisor effort does not ↑ monotonically with level of incentives received by supervisor ► Table
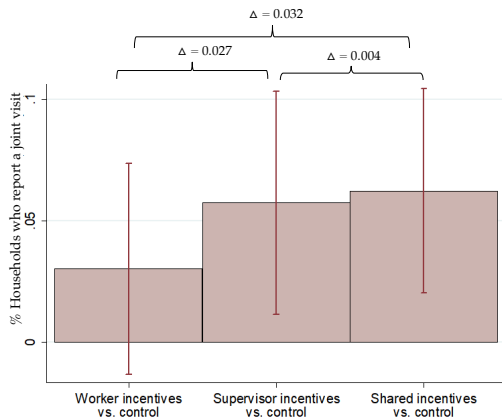
Notes: Mean in the control group = 0.164
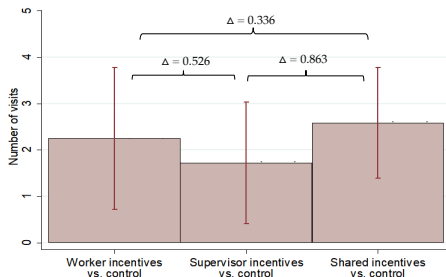*** p<0.01, ** p<0.05, * p<0.1

Heterogeneous Effects by Experience

▶ Stronger effect of shared incentives for inexperienced workers, more "enabled" by supervisor ▸ Table

High Effort Complementarity
[Workers with Experience Below Median]

Δ = 1.426**
Δ = 0.522   Δ = 1.266**

Number of visits

Worker incentives vs. control | Supervisor incentives vs. control | Shared incentives vs. control

Notes: Mean in the control group = 4.749
*** p<0.01, ** p<0.05, * p<0.1

Low Effort Complementarity
[Workers with Experience Above Median]

Δ = 0.336
Δ = 0.526   Δ = 0.863

Number of visits

Worker incentives vs. control | Supervisor incentives vs. control | Shared incentives vs. control

Notes: Mean in the control group = 5.953
*** p<0.01, ** p<0.05, * p<0.1

Mediation Analysis
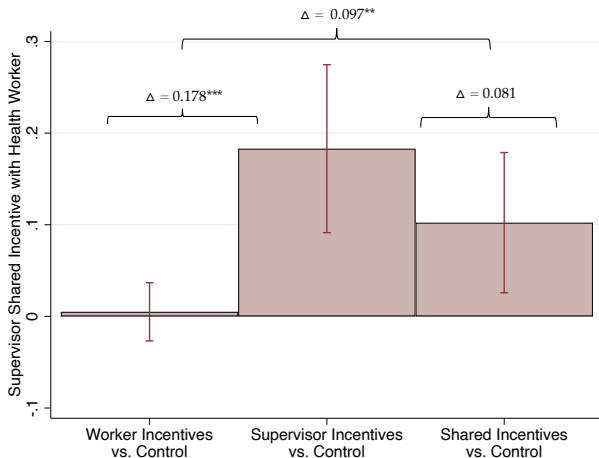
▶ Portion of the treatment effect that comes from worker effort ↑ with supervisor effort [Acharya et al. 2016] ▸ More
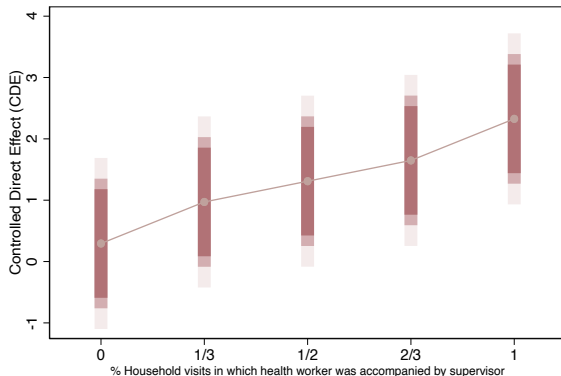
2. Contractual Frictions

Side-Payments

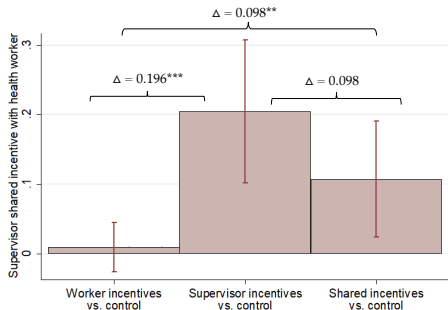- ▶ Few supervisors transfer incentives to the worker in the form of side-payments ⟨▸ Table⟩

Notes: Mean in the control group = 0.011
*** p<0.01, ** p<0.05, * p<0.1

Heterogeneous Effects by Observability
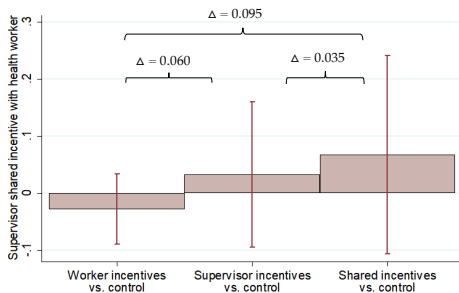
▶ More transfers from supervisors who can better observe worker effort (as per their reported ranks) ▸ Table ▸ Rel.Contract

High Observability of Health Worker Effort

Notes: Mean in the control group = -0.013
*** p<0.01, ** p<0.05, * p<0.1

Low Observability of Health Worker Effort

Notes: Mean in the control group = 0.000
*** p<0.01, ** p<0.05, * p<0.1

Alternative Mechanisms

1. **Aversion to pay inequality**: one-sided incentives perceived as unfair and ↓ effort of non-incentivized layer
   [Breza et al. 2018, Deserranno et al. 2021]

   - ► <10% workers know about supervisor incentives
   - ► No heterog. effect by worker inequality aversion ▸ Figure
   - ► Worker incentives ↑ supervisor effort wrt control ▸ Table

2. **Non-linear utility/cost function**: marginal utility generated by the incentive ↓ rapidly after $0.25 (SLL 1k) for both supervisors and workers
   - ► No sharp discontinuity in the treatment effects by marginal utility (wealth) or effort cost (distance) ▸ Figure

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Identification and Estimation

- ▶ Structurally estimate our model using
  - ▶ a classical minimum distance estimator [Wooldridge 2010, Della Vigna 2018]
  - ▶ moments of our data capturing visits and supervisor effort in each treatment group

- ▶ Estimated model precisely reproduces key findings ▸Table

- ▶ Estimated parameters confirm strong effort complementarity and large contractual frictions ▸Table
  - ▶ complementarity raises return to worker effort by 36%
  - ▶ transfer of 1 unit costs 3 units to the supervisor

Counterfactual Policy: Optimal Incentive p^*
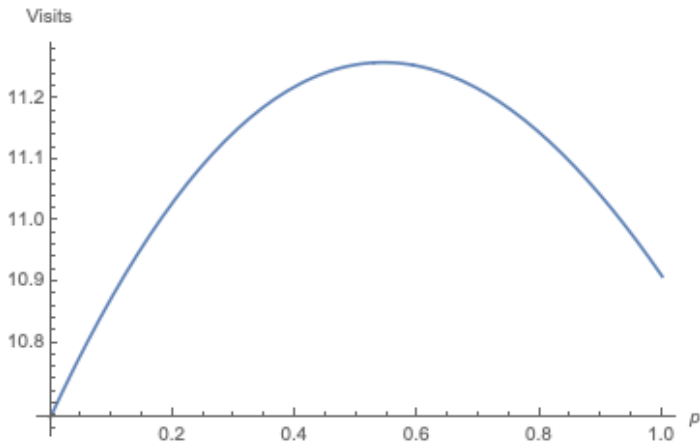
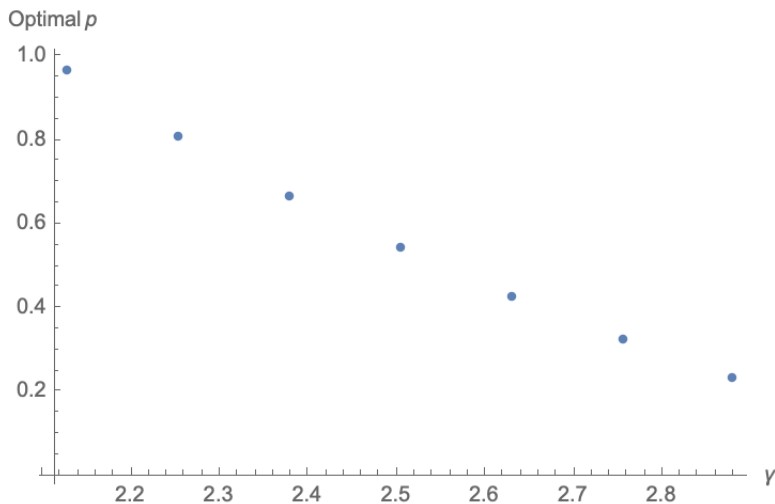# Counterfactual Policy: Optimal Incentive p^* by Complementarity γ

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Discussion

- Sharing output incentives can be optimal in organizations with complementarities and contractual frictions.
  - boost in output is 61% larger with two-sided than one-sided incentives

- Would it have been better to incentivize effort directly rather than joint output?
  - structural model suggests that tying incentives to joint output is more effective ▸ Graph
  - helps agents internalize the external effect of their effort on others

- Important to calibrate incentives in different types of organizations

The End

Thank you!

Comments and suggestions are very welcome!

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Counterfactual Policy: Incentivizing Joint Output is More Effective than Incentivizing Effort