Segregation or Diversification of Employees

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Motivation

- Group-based homophily preferences
  - Gender, caste, religion, nationality
- Context- dependent
  - No evidence of discrimination for software jobs but significant presence in the case of call-center jobs [*Banerjee et al. (2009)*]
- Firm characteristics and its Composition [*Chakraborty and Mahajan (2025)*]
  - Higher female proportion in larger firms
  - Size firm is positively correlated with TFP

IS PRODUCTIVITY IMPORTANT FOR COMPOSITION?

Roadmap

Overview

- Setup: Employee recruitment
- Employees' discriminatory taste against another group
- Firm chooses its optimal workforce composition
- Explore tradeoff between *Segregation* (only single group) and *Diversification* (both groups)
- Tradeoff for diversification:
  - Cost: Increased wage bill to compensate disutility for another group ***Homophily effect***
  - Benefit: Access skilled and willing workers from a broader pool ***Outreach effect***
- Result: As the factor productivity of the firm increases, the firms have greater incentives to diversify their workforce.

Research question

- How does the profit-maximizing firm choose its workforce composition under homophily preferences?
- How do the composition structures evolve under productivity dynamics?

Literature Review

- **Taste-based discrimination** *[Becker (1957)* , *Arrow (1971)*]
  - Substitutability between groups *[Welch (1967)]*
- **Group productivity and diversification**
  - Increase in own-caste group members improves individual productivity *[Afridi et al. (2024)]*
  - Better women representation linked to better performance *[Jain (2022)]*

Model

- Workers
  - Worker's type = {Gender, Skill, Preference}
  - Gender groups, g={M,F} each of a unit mass
  - Preference type $\theta_i \sim U[0,1]$ ***Unobservable***
  - Skill type $\rho_i = \{H, L\}$ where $H > L$ ***Observable***
  - p is the proportion of H type
  - Utility of worker $i \in (g, \rho_i, \theta_i)$ is $U_i = w_i + k\theta_i\eta_g$ where $\eta_g = \frac{n_g}{(n_M+n_F)}$
  - θ_i: Intensity of homophily and willingness to work
  - Outside option = c
- Firm
  - A profit maximising monopsony firm
  - Output generated $Y = \Sigma_i Y_i$; $Y_i(\rho_i) = \rho_i \cdot A$
  - No employers' discrimination

Timeline

We consider a two-stage game:

- *Stage 1:* Wage rate w_i to each worker simultaneously **Firm Offers**
- *Stage 2:* Simultaneously decide whether to accept or reject the contract **Workers' Respond**

Note: Given the informational assumptions, individual wages can be conditioned on gender, and productivity, but not on their preference parameter.

Solution

- We solve this problem using the concept of Subgame Perfect Nash Equilibrium
- In equilibrium,
  - Given the firm's contract and other workers' decisions, the worker's optimally choose their joining decision
  - Firms choose the wage contract to maximize their profits given the workers' joining decision

Firm's Problem

$$\max_{w_i} \pi = \pi_{M,H} + \pi_{M,L} + \pi_{F,H} + \pi_{F,L}$$

$$\text{subject to} \quad U_i^{\text{accept}} \geq U_i^{\text{reject}}$$

$$\pi_{M,H} = p \cdot \int_i (\rho_i \cdot A - w_i)\, d\theta_i \; ; i \in (M, H)$$
$$\pi_{M,L} = (1 - p) \cdot \int_i (\rho_i \cdot A - w_i)\, d\theta_i \; ; i \in (M, L)$$
$$\pi_{F,H} = p \cdot \int_i (\rho_i \cdot A - w_i)\, d\theta_i \; ; i \in (F, H)$$
$$\pi_{F,L} = (1 - p) \cdot \int_i (\rho_i \cdot A - w_i)\, d\theta_i \; ; i \in (F, L)$$

Workers' Problem

Definition: For a worker with ρ_i skill and g gender, let, $\theta^g_{\rho_i}$ denote the preference type and $\bar{\theta}^g_{\rho_i}$ denote the preference type of threshold worker such that all workers with preference type $\theta^g_{\rho_i} \geq \bar{\theta}^g_{\rho_i}$ choose to accept the contract.

Lemma

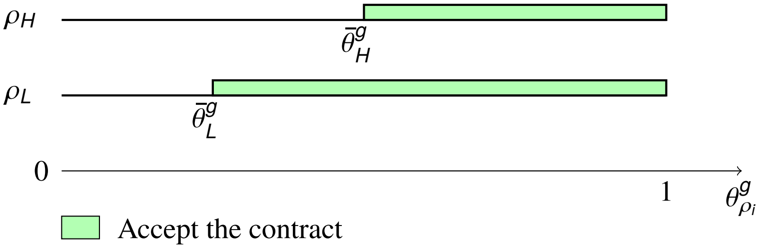
For each skill type ρ_i and gender g,

1. *There exists a well-defined $\bar{\theta}^g_{\rho_i} \in [0, 1]$.*
2. *In equilibrium, the worker with preference type $\bar{\theta}^g_{\rho_i}$ is indifferent between accepting and rejecting the contract i.e. $U(\bar{\theta}^g_{\rho_i}) = c$.*

Intuition:

1. For each $\{\rho_i, g\}$, if a given preference type accepts then all workers with a greater preference type also accept
2. Monopsony power to offer minimum wages to the threshold worker

Workers' acceptance



Wage function

$$w^g_{\rho_i} = \begin{cases} c - k\bar{\theta}^g_{\rho_i}\eta_g & \text{if } \bar{\theta}^g_{\rho_i} \in [0,1) \\ c - k & \text{if } \bar{\theta}^g_{\rho_i} = 1 \end{cases}$$

As $\bar{\theta}^g_{\rho_i}$ increases, it has two opposing effects on $w^g_{\rho_i}$.

- Satisfy the utility requirement of lesser workers ***(Willingness effect)*** of ρ_i skill and g group (1- $\bar{\theta}^g_{\rho_i}$) $\downarrow$ so $w^g_{\rho_i} \downarrow$.
- Decreasing proportion of gender group ***(Homophily effect)*** $\eta_g \downarrow$ so $w^g_{\rho_i} \uparrow$.

The thresholds of other groups $\bar{\theta}^{g'}_{\rho'_i}$ affect their own wages $w^g_{\rho_i}$ through homophily effect only.

Equivalence

Lemma

The problem of maximizing firm profit with respect to the wage vector is isomorphic to maximizing firm profit with respect to the cutoff vector

Firm's Problem

$$\max_{\bar{\theta}^g_{\rho_i}} \pi = \pi_{M,H} + \pi_{M,L} + \pi_{F,H} + \pi_{F,L}$$

$$\text{subject to} \quad \bar{\theta}^M_H,\ \bar{\theta}^M_L,\ \bar{\theta}^F_H,\ \bar{\theta}^F_L \in [0,1]$$

$$\pi_{M,H} = p(1-\bar{\theta}^M_H)(A\cdot\rho_H - c + k\bar{\theta}^M_H\eta_M)$$
$$\pi_{M,L} = (1-p)(1-\bar{\theta}^M_L)(A\cdot\rho_L - c + k\bar{\theta}^M_L\eta_M)$$
$$\pi_{F,H} = p(1-\bar{\theta}^F_H)(A\cdot\rho_H - c + k\bar{\theta}^F_H\eta_F)$$
$$\pi_{F,L} = (1-p)(1-\bar{\theta}^F_L)(A\cdot\rho_L - c + k\bar{\theta}^F_L\eta_F)$$

Simulation results

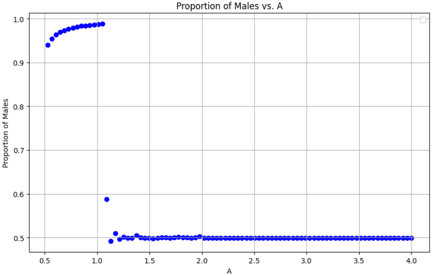


Figure: Numerical maximisation

Standard uniform distribution, $c = 3, p = 0.5, \rho_H = 3, \rho_L = 2, k = 2$

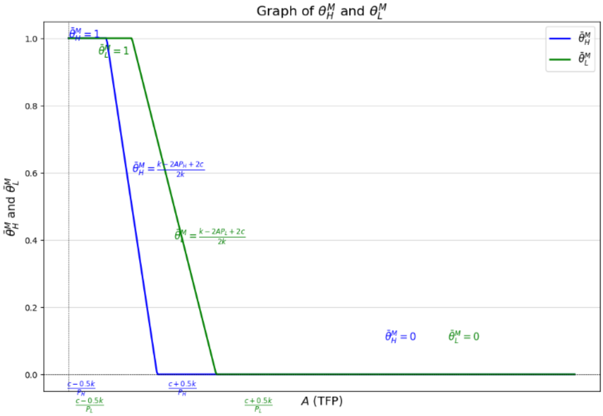
Observation: $\eta_M = \{0, 1, \frac{1}{2}\}$

Methodology

- Two solution classes: Segregation & Symmetric Diversification.
- Derived the solution within each class.
- Compare the firm's profits under two solution classes to determine the optimal workforce composition.

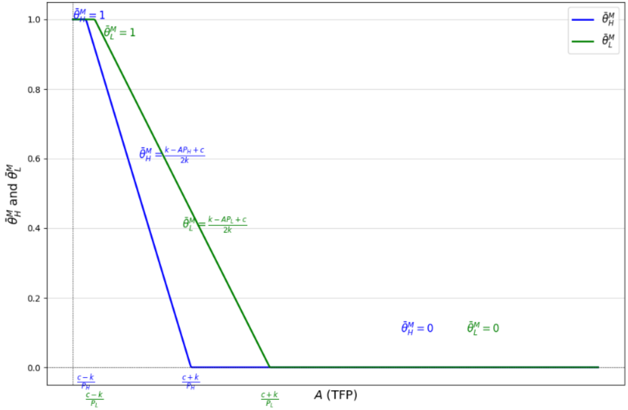
Symmetric diversification

Same thresholds across gender groups i.e. $\bar{\theta}_H^M = \bar{\theta}_H^F, \bar{\theta}_L^M = \bar{\theta}_L^F$.



Segregation (Male-dominant)

No females would be hired i.e. $\bar{\theta}_H^F = \bar{\theta}_L^F = 1$.



Summary of Results

- The firm hires a greater number of high-skill than low-skill workers ($\bar{\theta}_H^g \leq \bar{\theta}_L^g$) by offering them a greater wage rate i.e. $w_H^g \geq w_L^g$.
- During low productivity levels, the homophily effect dominates so the firm segregates its workforce.
- Also, at high productivity levels, the outreach effect dominates so the profits from diversification exceed segregation.
- As the firm's productivity increases, at least one switching point must exist wherein the firm switches its strategy from segregation to diversification.

Result: Homogeneous Skill

Definition: Let, $\hat{A}_{\rho_i}$ denotes the productivity threshold wherein the firm switches its strategy from segregation to diversification for ρ_i skill type *i.e.* firm segregates for $A < \hat{A}_{\rho_i}$ and diversifies for $A > \hat{A}_{\rho_i}$.

Proposition

Suppose that the workers are either all skilled or all unskilled, i.e. $p \in \{0, 1\}$, *a unique threshold exists for each skill type, i.e.* $\hat{A}_H = \frac{c}{\rho_H}$ *if* $p = 1$ *and* $\hat{A}_L = \frac{c}{\rho_L}$ *if* $p = 0$.

Intuition:

- Absence of the skill effect.
- Given the mass of each gender, the homophily effect is dominated by the willingness effect.

Result: Heterogeneous Skill

Proposition

Suppose skill levels are heterogenous, i.e. $p \in (0, 1)$ *and* $\hat{A}$ *denote the productivity threshold. Then, there exists a unique* $\hat{A}$ *if*

(1) $\frac{\rho_H}{\rho_L} < \frac{c}{c - 0.5k}$

(2) $\frac{c}{c-0.5k} < \frac{\rho_H}{\rho_L} < \frac{c}{c-k}$ *and* $p \geq \frac{\rho_L^2}{3\rho_H^2 + \rho_L^2} \equiv \hat{p}_1$

(3) $\frac{\rho_H}{\rho_L} > \frac{c}{c-k}$ *and* $p \geq \frac{(\frac{k+A\rho_L - c}{2})^2}{(\frac{k+A\rho_L-c}{2})^2 + (0.5k - c + A\rho_H)^2 - (\frac{k+A\rho_H-c}{2})^2} \equiv \hat{p}_2.$

Otherwise, there exists one or two $\hat{A}$.

Intuition:

- **Case 1:** The effect of skill differential is weak
- **Cases (2 & 3):** The outreach effect remains dominant when there is a greater proportion of skilled workers($p > \hat{p}$) amplifying the strength of skill benefits.
- **Summary:** A unique productivity threshold holds if either skill differential is minimal or there is a greater proportion of high-skill workers.

Robustness Checks

- Distribution of preferences (Normal, log-normal, beta)
- Non-symmetric gender groups
  - Unequal labor supply link
  - Unequal outside option link
  - One-sided homophily link

Implications

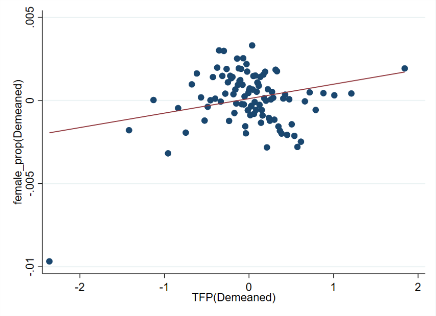
- Focus on efficiency motives(Productivity) automatically solves equality (Diversity) targets
- Affirmative actions may not be required in a productive economy

Productivity enhancement: A possible way to increase diversity

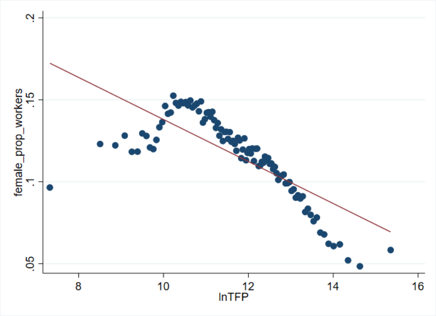
Empricial Corroboration

- **Objective:** Association between factor productivity and gender diversity
- **Dataset:** ASI Panel Data (2008-2020)
- **Main Variables:**
  - Gender diversity
    - Proportion of female workers(or man-days)
    - Based on workers in permanent employment
  - Total factor productivity(TFP)
    - Used *Levinsohn & Petrin(2003)* methodology
    - STATA command: *levpet*

Association



With fixed effects



Without fixed effects

Fixed effects include Firm, State*time, Industry(4 digit NIC)*time, Time

Intensive margin: Proportion of female

Empirical Strategy

$$Female\_prop_{ijst} = \beta_0 + \beta_1 lnTFP_{ijst} + \delta_i + \delta_{jt} + \delta_{st} + \delta_t + \epsilon_{ijst}$$

We observe i_{th} firm in j_{th} industry, s state and at t time

	1	2
VARIABLE	Female Proportion	
lnTFP	.028813 ***	-3.01e-11
	(0.002337)	(2.78e-11)
Constant	0.0053111	-.0133144
	(0.8859062)	(.1980283)
Mean	.125	.125
Observations	5,35,922	535,922
Firm F.E.	Yes	No
State*Time FE	Yes	Yes
Industry*Time FE	Yes	Yes
Time FE	Yes	Yes

Extensive margin: Proportion of female

Empirical Strategy

$$Female_{ijst} = \beta_0 + \beta_1 lnTFP_{ijst} + \delta_i + \delta_{jt} + \delta_{st} + \delta_t + \epsilon_{ijst}$$

$$\text{female} = \begin{cases} 1 & \text{if female proportion} > 0 \\ 0 & \text{otherwise} \end{cases}$$

	1	2	3
VARIABLE	Female		
lnTFP	0.0153***	-0.0816***	-0.145***
	(0.00564)	(0.00425)	(0.00364)
Constant	-0.234***	-1.167***	1.138***
	(0.0897)	(0.112)	(0.0416)
Mean of Female	0.5114474	0.5114474	0.5114474
Pseudo R2	0.0163	0.1533	0.0073
Observations	535,759	535,921	535,921
Firm F.E.	Yes	No	No
State*Time FE	Yes	Yes	No
Industry*Time FE	Yes	Yes	No
Time FE	Yes	Yes	No

Empirical Strategy

$$lnY_{ijst} = \beta_0 + \beta_1 lnTFP_{ijst} + \delta_i + \delta_{jt} + \delta_{st} + \delta_t + \epsilon_{ijst}$$

Y={No. of female workers, No. of total workers}

	1	2
VARIABLES	ln total workers	ln female workers
lnTFP	0.135***	0.0984***
	(0.00314)	(0.00675)
Constant	1.582***	1.180***
	(0.0359)	(0.0778)
All F.E.	Yes	Yes
Mean Y	67.11	0.125
Observations	460,289	133,362
R-squared	0.924	0.907

Thank You !!

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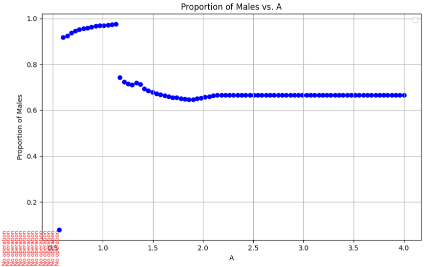
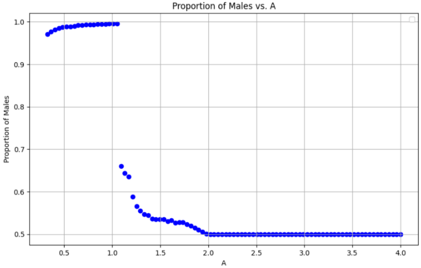
Unequal labor supply



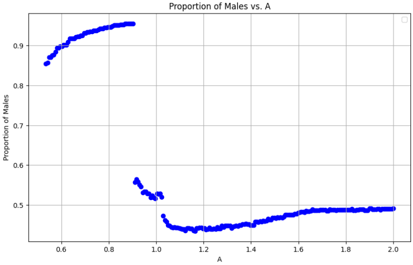
$\eta_M = \{1, \frac{2}{3}\}$

Unequal outside option



$\eta_M = \{1, \frac{1}{2}\}$

One-sided homophily



$\eta_M = \{1, \frac{1}{2}\}$

Future directions: Model Refinement

Rationalize the non-symmetric diversification

- Due to the presence of social norms, on an average women supply less labor as compared to men.
- Introduce an unequal mass of labor supply

Perform preference concavification

- $U_{ikj} = w_{kj} + \theta_i^k \cdot \sqrt{n_{kj}}$
- Explain why diversity motive costs more to smaller firms

Calculate the cost of diversity

- Quantify the wage compromise/premium for diversity motives
- Use hedonic wage literature and evaluate each job attribute

Impact of Affirmative action (AA)

- Welfare of all the groups(male, female) and the firm
- Trivially, the firm would be worse off
- Enhance the welfare of all workers and take out firms from inferior equilibriums