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Group Reputation
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Issues in Economic Systems and Institutions: Part V: Reputation

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May 8, 2013

Individual Reputation
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Reputational Herding

Group Reputation
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Reputational Herding (Scharfstein and Stein 1990)

▶ Variation on the theme of informational cascades.

▶ Agents have no direct payoff from the decision—they are investing other people's money.

▶ Agents want to enhance their reputation for expertise.

▶ A critical assumption:

  ▶ signals of good experts are correlated (great minds think alike)
  ▶ signals of bad experts are uncorrelated (fools often differ)

▶ Reputation is enhanced by: (a) taking the right decision (b) agreeing with other experts.

▶ (b) may be so strong that all experts mimic the choices of their predecessors.

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The Model

- ▶ Two fund managers: A and B.
- ▶ Each manager chooses to invest (I) or not (N).
- ▶ Return on investment is either high $(x_H > 0)$ or low $(x_L < 0)$, with equal likelihood.
- ▶ Manager A chooses first, then manager B.
- ▶ Each manager receives a private signal, which is either good (s_G) or bad (s_B).
- ▶ The second manager can observe the first manager's action but not his signal.

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Information

- ▶ Each manager is either smart (prob θ) or dumb (prob $1 - \theta$).
- ▶ Managers do not know the quality of their own signals.
- ▶ Smart manager's signal (informative but noisy):

	s_G	s_B
x_H	p	$1 - p$
x_L	$1 - p$	p

- ▶ Dumb manager's signal (pure noise):

	s_G	s_B
x_H	$\frac{1}{2}$	$\frac{1}{2}$
x_L	$\frac{1}{2}$	$\frac{1}{2}$

- ▶ Smart signals perfectly correlated, dumb signals independent.

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Reputation

- ▶ $\Pr[s_G|\text{smart}] = \Pr[s_G|\text{dumb}]$, hence each signal in itself conveys no information about expertise.

- ▶ Two signals together convey some information about expertise (matched signals good news).

- ▶ Market observes each manager's action but not signal.

- ▶ Also learns the state of the world (x_H or x_L) eventually.

- ▶ Revises the probability that an expert is smart to some $\widehat{\theta}$.

- ▶ Experts are interested in maximizing expected value of reputation ($\widehat{\theta}$) because their future salaries are linked to it.

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Benchmark 1A: Single Investor, One Signal

▶ Suppose there is a single investor who invests his own money, i.e., cares about returns, not reputation.

▶ Conditional probabilities after each signal:

$$
\begin{aligned}
\mu_G &= \Pr[x_H|s_G] = \theta p + (1-\theta).\frac{1}{2} \\
\mu_B &= \Pr[x_H|s_B] = \theta(1-p) + (1-\theta).\frac{1}{2}
\end{aligned}
$$

▶ Assume:

$$
\mu_B x_H + (1 - \mu_B) x_L < 0 < \mu_G x_H + (1 - \mu_G) x_L
$$

▶ Optimal decision is dependent on the signal.

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Benchmark 1B: Single Investor, Two Signals

▶ Suppose the investor knows two signals.

▶ Given previous assumption, the optimal decision rule (which maximizes returns) is:
  ▶ if (s_G, s_G), choose I.
  ▶ if (s_B, s_B), choose N.
  ▶ if (s_G, s_B) or (s_B, s_G), depends.

▶ If the signals are opposite they wash out, i.e.,
  $\Pr[x_H | s_G, s_B] = \frac{1}{2}$.

▶ Then I if $x_H + x_L > 0$, and N if $x_H + x_L < 0$.

▶ It is not optimal to simply follow the first signal.

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Benchmark 2: Single Manager

▶ Suppose there is a single manager who cares about reputation, not returns.

▶ If the expert is expected to invest under s_G and not invest under s_B, will he behave accordingly (i.e. reveal his signal)?

▶ The manager's reputation goes up when he is correct and goes down when he is wrong:

$$\widehat{\theta}\left(s_G, x_H\right) = \widehat{\theta}\left(s_B, x_L\right) > \theta > \widehat{\theta}\left(s_G, x_L\right) = \widehat{\theta}\left(s_B, x_H\right)$$

▶ The manager thinks the state is more likely to be what his signal indicates:

$$\Pr[x_H|s_G] = \Pr[x_L|s_B] > \frac{1}{2} > \Pr[x_H|s_B] = \Pr[x_L|s_G]$$

▶ The expected reputation is greater if he reveals his signal than if he misreports it.

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Equilibrium

Theorem
In equilibrium, manager A always invests if he gets s_G and does not invest if he gets s_B.

▶ We will show that manager B always mimics manager A, regardless of his own signal.

▶ Then, A's reputation is affected only by his own actions.

▶ A single manager will always reveal his signal (previous slide).

▶ There is also a "perverse" equilibrium where he reveals his signal by taking the wrong action. Rule it out (suppose he has a small stake in returns).

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Equilibrium

Theorem
There is no equilibrium in which manager B always reveals his signal.

▶ Suppose there is a revealing equilibrium.

▶ Suppose (w.l.o.g) A's signal is revealed as s_B, but manager B's signal is s_G.

▶ We will show that manager B will misreport his signal as s_B.

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Outline of Proof

▶ Two conflicting signals cancel each other out (nobody knows who is the dumb one!)

$$\Pr[x_H|s_B, s_G] = \frac{1}{2}$$

▶ Incentive constraint for truthfully reporting s_G:

$$\frac{1}{2}\widehat{\theta}\left(s_B, s_G, x_H\right) + \frac{1}{2}\widehat{\theta}\left(s_B, s_G, x_L\right)$$

$$\geq \quad \frac{1}{2}\widehat{\theta}\left(s_B, s_B, x_H\right) + \frac{1}{2}\widehat{\theta}\left(s_B, s_B, x_L\right)$$

▶ In words:

expected reputation (truth-telling) $\geq$ expected reputation (lying)

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Outline of Proof

▶ However

$$\underbrace{\widehat{\theta}\left(s_B, s_G, x_H\right)}_{\text{agrees with state alone}} < \underbrace{\widehat{\theta}\left(s_B, s_B, x_L\right)}_{\text{agrees with both}}$$

$$\underbrace{\widehat{\theta}\left(s_B, s_G, x_L\right)}_{\text{disagrees with both}} < \underbrace{\widehat{\theta}\left(s_B, s_B, x_H\right)}_{\text{disagrees with state alone}}$$

▶ When signals conflict, either prediction has the same chance of being correct.

▶ Ceteris paribus, agreeing with other expert will increase the likelihood of being perceived smart.

▶ It is better to be wrong with others than to be wrong alone!

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Equilibrium

Theorem

There is an equilibrium in which manager B always does the same thing as manager A, regardless of his own signal..

▶ "Reasonable" off-the-equilibrium-path beliefs: if B disagrees with A, then his signal is s_G if he chose I and s_B if he chose N.

▶ Incentive constraint:

$$\theta \geq \frac{1}{2}\widehat{\theta}\left(s_B, s_G, x_H\right) + \frac{1}{2}\widehat{\theta}\left(s_B, s_G, x_L\right)$$

or, $\theta - \widehat{\theta}\left(s_B, s_G, x_L\right) \leq \widehat{\theta}\left(s_B, s_G, x_H\right) - \theta$

▶ Intuition: reputation loss from being wrong alone is greater than reputation gain from being right alone.

Political Correctness (Morris 2001)

- ▶ Listeners are often unsure about the bias of speakers (are they sexist/racist/casteist)?

- ▶ What is said reveals something about both the speaker's information as well as his motives.

- ▶ Message affects reputation and vice versa.

- ▶ Political correctness: even unbiased speakers lie! They lie in a direction opposite to the suspected bias.

- ▶ In the extreme, political correctness leads to babbling: everyone says the "safe" thing.

- ▶ PC may be socially inefficient due to informational loss. Important policy issues are not discussed frankly.

- ▶ Possibility of multiple equilibria: different speech cultures.

The Model

- ▶ Two periods: $t = 1, 2$. State-of-the-world at date t: $\omega_t \in \{0, 1\}$. Equi-probable and time-independent.
- ▶ Two players: decision maker (D) and advisor (A).
- ▶ D chooses action $a_t \in \mathbf{R}$ each period. D's payoff:

$$U_D = -x_1(a_1 - \omega_1)^2 - x_2(a_2 - \omega_2)^2$$

- ▶ A can be good (prob λ_1) or bad (prob $1 - \lambda_1$).
- ▶ Good advisors have the same preference as D, bad advisors always want higher action:

$$U_A^b = y_1 a_1 + y_2 a_2$$

- ▶ $\frac{x_2}{x_1}$ and $\frac{y_2}{y_1}$ represent relative importance of the future.

The Model

▶ The advisor gets an independent noisy signal of the state each period: $s_t \in \{0, 1\}$.

▶ Accuracy of the signal is $\gamma \in \left(\frac{1}{2}, 1\right)$:

	$s = 0$	$s = 1$
$\omega = 0$	γ	$1 - \gamma$
$\omega = 1$	$1 - \gamma$	γ

▶ Each period, A sends message $m_t \in \{0, 1\}$.

▶ After date 1, D learns ω_1 and updates his belief to λ_2.

▶ $\lambda_2 \left(\lambda_1, m_1, \omega_1 \right)$ is the advisor's new reputation.

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Full Information Benchmark

▶ If A was known to be good, messages would be truthful and credible.

▶ Optimal actions equal to expected value of the state:

$$
\begin{aligned}
a^*(0) &= \Pr[\omega = 1|s = 0] = 1 - \gamma \\
a^*(1) &= \Pr[\omega = 1|s = 1] = \gamma
\end{aligned}
$$

▶ Good advisor wants exactly these actions.

▶ Bad advisor always wants $a = 1$, regardless of state.

▶ Without reputational concerns, good advisor reports true value of signal. Bad advisor lies and reports 1 even if signal is 0.

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Last Period

▶ Message strategies

	$s_2 = 0$	$s_2 = 1$
Good	0	1
Bad	1	1

▶ Optimal actions, $a_2\,(m_2; \lambda_2)$:

$$a_2(0; \lambda_2) = 1 - \gamma$$
$$a_2(1; \lambda_2) = \Pr\left[\omega_2 = 1 | m_2 = 1\right]$$

$$= \frac{1 - \lambda_2(1-\gamma)}{2 - \lambda_2}$$

▶ $a_2(1; \lambda_2) \uparrow$ as $\lambda_2 \uparrow$ and $\rightarrow \gamma$ as $\lambda_2 \rightarrow 1$.

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Value of Reputation

- ▶ Let $v_G\left(\lambda_2\right)$ and $v_B\left(\lambda_2\right)$ denote expected payoff to good and bad advisor in the last period.

- ▶ The bad advisor always reports $m_2 = 0$:

$$v_B\left(\lambda_2\right) = y_2 a_2(1; \lambda_2) \uparrow \text{ in } \lambda_2$$

- ▶ The good advisor always reports truthfully:

$$v_G\left(\lambda_2\right) = -x_2 \cdot \frac{1}{2}\left[\mathbf{E}\left(\left(a_2 - \omega_2\right)^2 | s_2 = 0\right) + \mathbf{E}\left(\left(a_2 - \omega_2\right)^2 | s_2 = 1\right)\right.$$

- ▶ First term is minimized at $a_2 = 1 - \gamma$, second term at $a_2 = \gamma$.
- ▶ $a_2\left(1; \lambda_2\right) \uparrow$ towards γ as $\lambda_2 \uparrow$. Both types value reputation.

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First Period

▶ Assume equilibrium with no political correctness, i.e., good A reports truthfully.

▶ Bad A must falsely report the truth sometimes. Suppose not:

	$s_1 = 0$	$s_1 = 1$
Good	0	1
Bad	0	1

▶ Then $\lambda_2 (\lambda_1, m_1, \omega_1) = \lambda_1$ for any m_1 and ω_1. Message does not affect reputation.

▶ Also, message is believed completely:
  $a_1(0) = 1 - \gamma < \gamma = a_1(1)$. Bad advisor will lie and always report 1.

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First Period

- ▶ Assume good advisor always reports truthfully; bad advisor sometimes lies.

	$s_1 = 0$	$s_1 = 1$
Good	0	1
Bad	0 (prob $1 - v$)	1
	1 (prob v)	

- ▶ Then $m_1 = 0 \Rightarrow s_1 = 0$, but $m_1 = 1$ does not $\Rightarrow s_1 = 1$.
- ▶ Equilibrium actions $a_1\,(m_1)$:

$$a_1\,(0) \;=\; 1 - \gamma$$

$$a_1\,(1) \;\in\; \left(\frac{1}{2}, \gamma\right)$$

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Reputation

- ▶ Reputation is enhanced if message is
  - ▶ (i) factually correct
  - ▶ (ii) politically correct.
- ▶ Ceteris paribus, initial reputation positively affects final reputation.
- ▶ Comparison for $\lambda_2 (\lambda_1, m_1, \omega_1)$:

$$\lambda_2 (\lambda_1, 0, 1) = \lambda_2 (\lambda_1, 0, 0) > \lambda_1 > \lambda_2 (\lambda_1, 1, 1) > \lambda_2 (\lambda_1, 1, 0)$$

- ▶ Exact expressions involve v and can be calculated using Bayes' Rule.

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Reputation Rankings: Intuition

▶ Politically correct message ($m_1 = 0$) enhances reputation regardless of factual correctness. Reason:

   ▶ the good type sends $m_1 = 0$ more often than the bad type.
   ▶ $m_1 = 0$, $\omega_1 = 1$ is always an honest mistake.

▶ Politically incorrect message ($m_1 = 1$) harms reputation even when factually correct!

   ▶ the bad type sends $m_1 = 1$ more often than the good type.
   ▶ $m_1 = 1$, $\omega_1 = 1$ is sometimes dishonest yet accidental accuracy.

▶ $m_1 = 1$ causes further damage to reputation when factually incorrect.

   ▶ $m_1 = 1$, $\omega_1 = 0$ is sometimes a deliberate mistake.

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First Period Equilibrium

► **Condition 1:** when $s_1 = 0$, the bad advisor must be indifferent between truth-telling and lying:

$$y_1 a_1 (0) + \mathbf{E}\left[v_B\left(\lambda_2\right)|0,0\right] = y_1 a_1 (1) + \mathbf{E}\left[v_B\left(\lambda_2\right)|1,0\right]$$

$$\underbrace{y_1\left[a_1\left(1\right) - a_1\left(0\right)\right]}_{\text{gain from lying}} = \underbrace{\mathbf{E}\left[v_B\left(\lambda_2\right)|0,0\right] - \mathbf{E}\left[v_B\left(\lambda_2\right)|1,0\right]}_{\text{expected reputational loss}}$$

gain from lying = expected reputational loss

► When $s_1 = 1$, the bad advisor strictly prefers to tell the truth (implication of above).

► When $s_1 = 0$, the good advisor always wants to tell the truth (better outcome as well as better reputation).

► **Condition 2:** the good advisor must prefer to tell the truth when $s_1 = 1$ (algebra ommitted).

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Informative Equilibria: General Properties

▶ Good advisor sends $m_1 = 0$ whenever $s_1 = 0$. He announces $m_1 = 1$ with (weakly) positive probability if $s_1 = 1$.

   ▶ When $s_1 = 0$, both current and reputational payoffs are higher for $m_1 = 0$.

▶ Bad advisor sends $m_1 = 1$ more often than the good advisor.

   ▶ Otherwise there would be no reputational cost to sending $m_1 = 1$.

▶ There is a strict reputational incentive to be politically correct:

$$\lambda_2 \left(\lambda_1, 0, 1\right) = \lambda_2 \left(\lambda_1, 0, 0\right) > \lambda_1 > \lambda_2 \left(\lambda_1, 1, 1\right) > \lambda_2 \left(\lambda_1, 1, 0\right)$$

   ▶ Reasons as before.

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Extreme Political Correctness

- ▶ If $\frac{x_2}{x_1}$ is high enough, the only equilibrium is babbling.
- ▶ One way to depict the strategies:

	$s_1 = 0$	$s_1 = 1$
Good	0	0
Bad	0	0

- ▶ Both type of advisors say the "safe" thing so as not to damage their reputation and influence in the future.
- ▶ Reason: the bad advisor's indifference condition pins down reputational gain from $m_1 = 0$. Good advisor will want to capture this if x_2 is high enough.
- ▶ Under PC, **nothing** is learnt about the state or the speaker!

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Welfare

▶ Benchmark: a model where D in the 2nd period does not
know what happened in the 1st period (no reputational
incentives).

▶ Without reputation, strategies are in both periods are as in
last period of the game with reputation.

▶ Reputation creates 3 effects:

1. *Discipline effect*: bad advisor tells the truth more often
(announce $m_1 = 0$ when $s_1 = 0$). (+)
2. *Sorting effect*: decision maker learns something about the
speaker and his trustworthiness. (+)
3. *Political correctness effect*: even the good advisor starts lying
sometimes (send $m_1 = 0$ when $s_1 = 1$). (-)

▶ When we have an extreme PC (babbling) equilibrium, 3
dominates $1 + 2$.

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Taste Based Discrimination

What's In A Name?

▶ Bertrand and Mullainathan (*AER*, 2004): RCT for testing discrimination in job applications.

▶ Fictitious CVs randomly matched with white (Emily, Greg) and black (Lakisha, Jamal) sounding names.

▶ 5000 resumes submitted in response to 13000 employment ads in Boston and Chicago.

▶ Call back rates: whites $= 9.65\%$, blacks $= 6.45\%$. Whites have 50% higher call back.

▶ As resume quality improves, response rate goes up faster for whites than blacks.

▶ Blind auditions improve the chances of women violinists significantly (Goldin and Rouse, *AER* 2000).

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Taste Based Discrimination

Other Examples of "Discrimination"

▶ Insurance premiums: young drivers (under 25) and older health insurees (over 65) face higher rates.

▶ Airport screening: Middle Eastern males more likely to be terrorists than Swiss nuns.

▶ Residential choice and segregation: racial composition of a neighbourhood is a predictor of crime. Avoid the Bronx.

▶ Credit: 97% of Grameen bank loans are given to women.

▶ Racial profiling: Search rates from Knowles, Persico and Todd's (*JPE* 2001) data on 1,590 stop-and-search operations by Maryland police, 1995 - 99:

  ▸ Blacks = 63%, whites = 29%.
  ▸ Men = 93%, women = 7%.

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Three Notions of Discrimination

- **Incidental discrimination:** groups are not treated differently, but there is differential impact because groups differ statistically in behaviour (prison population disproportionately male because lawbreakers are disproportionately male).

- **Statistical discrimination:** groups are treated differently, but only insofar as group affiliation is a statistical predictor of behaviour (young people drive rash, on average).

- **Taste based discrimination:** groups are treated differently because doing so for its own sake generates utility (racial or caste-based segregation). Prejudice, pure and simple.

How do we empirically separate these strands?

Individual Reputation
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Group Reputation
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Taste Based Discrimination

Discrimination in Monitoring

- ▶ Crime as a rational choice: criminals commit an illegal act after weighing benefits against expected punishment cost (Becker, 1968).

- ▶ Two races, $r = A, W$. Observationally distinct to the police.

- ▶ Observable non-racial characteristic c follows distribution $n_r(c)$, with totals

$$N_r = \int n_r(c) dc$$

- ▶ Distribution of x, i.e. legal income opportunities: $F_r(x; c)$.

- ▶ Benefit of carrying drugs $= B$, penalty if caught $= P$.

- ▶ Police have enough resources to search only S people.

Individual Reputation
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Taste Based Discrimination

Group Reputation
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The Game and Equilibrium

- ▶ Individual decision: carry drugs or enter a legal profession?
- ▶ Police simultaneously choose $\sigma_r(c)$ —what proportion of group (r, c) to search, subject to the budget constraint

$$\sum_{r=A}^{W} \int n_r(c)\sigma_r(c)dc = S$$

- ▶ Police objective function:

$$U = \sum_{r=A}^{W} \int n_r(c)\sigma_r(c) \left[\theta_r(c) + u_r\right] dc$$

where u_r is the intrinsic utility/disutility of searching race r, and $\theta_r(c)$ is the "hit rate" among group (r, c).

Individual Reputation
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Taste Based Discrimination

Group Reputation
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The Testable Implication

▶ Interior equilibrium: police must be indifferent across groups, i.e. $\theta_r(c) + u_r$ is a constant.

▶ Expected payoff from drug peddling:

$$q(\sigma_r(c)) = (1 - \sigma_r(c))B - \sigma_r(c)P$$

▶ Those whose legal incomes are less, choose to commit crime:

$$\theta_r(c) = F_r(q(\sigma_r(c)))$$

▶ Equality is preserved after integrating over non-racial characteristics. Let $\theta_r = \int \theta_r(c)n_r(c)dc$. Then

$$\theta_A + u_A = \theta_W + u_W$$

Individual Reputation
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Taste Based Discrimination

Group Reputation
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Testable Implication

- ▶ If police are unprejudiced ($u_A = u_W$), **hit rates** will be equalized across groups, even if **search rates** are very different.

- ▶ If police are prejudiced against blacks ($u_A > u_W$), equilibrium hit rates will be **lower** among blacks.

- ▶ The general idea: compensating differentials.

- ▶ Onerous jobs pay more, attractive cities/neighbourhoods have higher rents.

- ▶ Does not require the econometrician to know or control for all the variables that police condition their decisions on.

Individual Reputation
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Taste Based Discrimination

Group Reputation
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Highway Search Data: Hit Rates

▶ Test of equality of means (Pearson's chi-squared):

$$\sum_{r=1}^{R} \frac{(\widehat{p}_r - \widehat{p})^2}{\widehat{p}_r} \sim \chi^2(R-1)$$

▶ Observed hit rates across racial and gender groups

	Black	White	Hispanic	All Races
Both sexes	.34	.32	.11*	.30
Male	.34	.33	.11	.32
Female	.44*	.22*	-	.36

▶ Null hypothesis of equality is not rejected when only whites
and blacks are used. Rejected when Hispanics are added.
▶ Evidence of taste based discrimination against Hispanics and
white females, but not males or blacks.

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Reputation

Individual Reputation
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Taste Based Discrimination

Group Reputation
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Efficiency

Theorem
If $u_A = u_W$ and $F_A = F_W = F$ is concave, the equilibrium allocation maximizes rather than minimizes aggregate crime rate.

- Let $N_A = N_W = N$ and $\sigma = \frac{S}{N}$. Budget constraint:

$$\frac{1}{2} \left[\sigma_A + \sigma_W\right] = \sigma$$

- Aggregate crime rate:

$$F_A(q(\sigma_A)) + F_W(q(2\sigma - \sigma_A))$$

- First-order condition holds at $f_A = f_W$ ($q'(.)$ is constant)):

$$f_A(q(\sigma_A)) = f_W(q(2\sigma - \sigma_A))$$

- Since the objective function is concave, this is a maximum!

Individual Reputation
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Group Reputation
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Taste Based Discrimination

Equilibrium, Fairness and Efficiency

▶ In general, they are described by three different conditions:

  ▶ Equilibrium: $F_A = F_W$, i.e. crime rates are equal.
  ▶ Fairness: $\sigma_A = \sigma_W$, i.e. search rates are equal.
  ▶ Efficiency: $f_A = f_W$, i.e. response elasticities are equal.

▶ Mandatory quotas (e.g. $\sigma_A = \sigma_W$) to improve fairness may improve efficiency or worsen it.

▶ Intuition: there is a conflict between two different objectives:

  ▶ discouraging crime (deterrence).
  ▶ catching as many criminals as possible (retribution).

▶ Dynamic inconsistency and problem of commitment.

Individual Reputation
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Taste Based Discrimination

Group Reputation
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An Example

- ▶ Extreme case: $F_W(q(2\sigma)) = 1$, i.e., Ws are completely unresponsive to higher scrutiny (zero response elasticity).

- ▶ Efficient allocation: $\sigma_W = 0$ and $\sigma_A = 2\sigma$.

- ▶ Equilibrium allocation is fairer but less efficient than this benchmark.

Individual Reputation
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Statistical Discrimination

Group Reputation
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Statistical Discrimination

- ▶ Skills a function of both innate ability and effort.
- ▶ Noisy measurement of skill $\Rightarrow$ priors will affect posteriors.
- ▶ Positive feedback loop between employer perceptions and worker effort:
  - ▶ if employers hold optmistic beliefs, workers may have a strong incentive to become skilled.
  - ▶ if employers hold pessimistic beliefs, workers may have a weak incentive to become skilled.
- ▶ Multiple equilibria are possible for some parameters.
- ▶ Different groups (e.g. blacks and whites) may get locked into different equilibria.
- ▶ Affirmative may improve or worsen stereotypes (beliefs about skill distribution in target population).

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Statistical Discrimination

Group Reputation
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The Coate-Loury model

- ▶ Two races: W (proportion λ) and B.
- ▶ Two kinds of tasks: unskilled (0) and skilled (1).
- ▶ Two worker types: qualified (q) and unqualified (u).
- ▶ Every worker (either race) could become qualified at a cost c which is private information. Within each group, $c \sim U[0,1]$.
- ▶ Payoffs to employers and workers:

	Skilled (1)	Unskilled (0)
Qualified (q)	x_q, w	$0, 0$
Unqualified (u)	$-x_u, w$	$0, 0$

- ▶ Noisy test of qualification:

	Pass	Unclear	Fail
Qualified (q)	$1 - p_q$	p_q	0
Unqualified (u)	0	p_u	$1 - p_u$

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Reputation

Individual Reputation
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Statistical Discrimination

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Employer and Worker Best Response

▶ Employers: Pass $\rightarrow 1$, Fail $\rightarrow 0$, Unclear $\rightarrow$?

▶ Let prior $= \pi$. Then posterior

$$\sigma = \Pr(q|\text{Unclear}) = \frac{\pi p_q}{\pi p_q + (1-\pi)p_u}$$

▶ Assigning skilled task after unclear test result is optimum iff

$$\sigma x_q + (1-\sigma)x_u \geq 0$$

$$\pi \geq \frac{p_u x_u}{p_u x_u + p_q x_q} = \widehat{\pi}$$

▶ Workers invest in qualification iff cost below a cutoff:

$$\begin{aligned}
\phi(\pi) &= \overline{c} = (1-p_u)w \ \text{ if } \pi \geq \widehat{\pi} \\
&= (1-p_q)w \ \text{ if } \pi < \widehat{\pi}
\end{aligned}$$

Individual Reputation
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Statistical Discrimination

Group Reputation
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Multiple Equilibria

▶ **Equilibrium with liberal beliefs:** suppose $\pi \geq \hat{\pi}$ in equilibrium $\Rightarrow$ unclear test result leads to skilled task. Condition:

$$\pi_l = \phi(\pi_l) = (1 - p_u)w \geq \hat{\pi}$$

▶ **Equilibrium with conservative beliefs:** suppose $\pi < \hat{\pi}$ in equilibrium $\Rightarrow$ unclear test result leads to unskilled task. Condition:

$$\pi_c = \phi(\pi_c) = (1 - p_q)w < \hat{\pi}$$

▶ Multiple equilibria exist if

$$\pi_c < \hat{\pi} \leq \pi_l$$

$$\text{or } (1 - p_q)w < \frac{p_u x_u}{p_u x_u + p_q x_q} \leq (1 - p_u)w$$

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Individual Reputation
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Statistical Discrimination

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Numerical Example

▶ Stability: suppose employer beliefs evolve the following way:

$$\pi^{t+1} = \phi(\pi^t)$$

The both equilibria are locally stable.

▶ Payoffs to employers and workers:

	Skilled	Unskilled
Qualified	1, 1	0, 0
Unqualified	−1, 1	0, 0

▶ Noisy test of qualification:

	Pass	Unclear	Fail
Qualified	$\frac{1}{4}$	$\frac{3}{4}$	0
Unqualified	0	$\frac{1}{2}$	$\frac{1}{2}$

Individual Reputation
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Group Reputation
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Statistical Discrimination

Employer's Hiring Strategy

▶ Employers: pass → manager, fail → clerk, unclear → ?

▶ Let fraction of qualified workers $= \pi$. After unclear test result

$$\sigma = \Pr(s|\text{Unclear}) = \frac{\pi.\frac{3}{4}}{\pi.\frac{3}{4} + (1-\pi).\frac{1}{2}} = \frac{3\pi}{2+\pi}$$

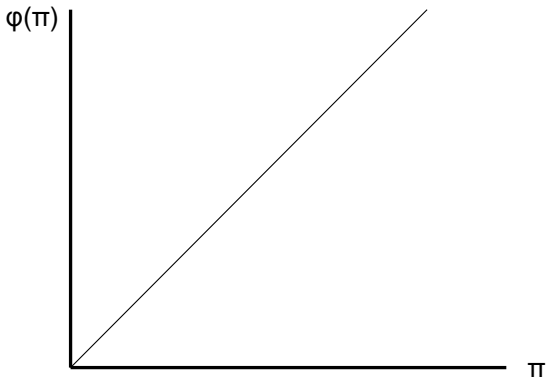▶ Assigning as manager after unclear test result is optimum iff

$$\sigma.1 + (1-\sigma)(-1) \geq 0 \Rightarrow \sigma \geq \frac{1}{2}$$

$$\text{or } \pi \geq \frac{2}{5}$$

Individual Reputation
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Group Reputation
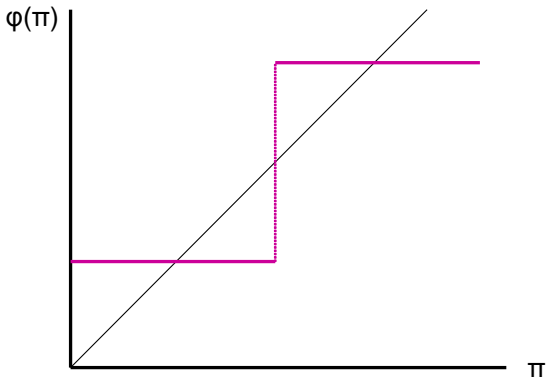○○○○○○○○○○
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Statistical Discrimination

Worker's Investment Strategy

► Let $\phi(\pi)$ = fraction of workers who **actually** acquire skills when employers **think** this fraction is π.

► **Optmistic beliefs:** $\pi \geq \frac{2}{5}$ (unclear $\rightarrow$ manager).

  ► Hiring probability if qualified = 1.
  ► Hiring probability if unqualified = $\frac{1}{2}$.
  ► Expected gain from skill = cost threshold for investment = fraction of qualified workers = $\phi(\pi) = \frac{1}{2}$.

► **Pessimistic beliefs:** $\pi \geq \frac{2}{5}$ (unclear $\rightarrow$ clerk).

  ► Hiring probability if qualified = $\frac{1}{4}$.
  ► Hiring probability if unqualified = 0.
  ► Expected gain from skill = cost threshold for investment = fraction of qualified workers = $\phi(\pi) = \frac{1}{4}$.

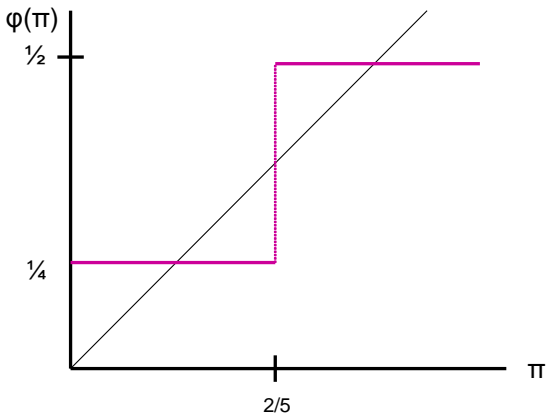► In equilibrium, employers' beliefs must be fulfilled: $\phi(\pi) = \pi$.

Individual Reputation
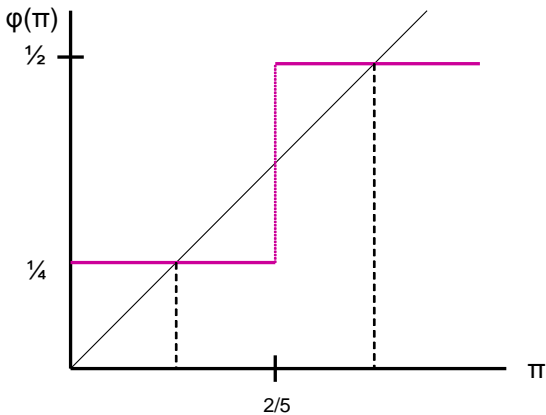○○○○○○○○○○○○○
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Statistical Discrimination

Group Reputation
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Multiple Equilibria

Multiple Equilibria

Individual Reputation
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Statistical Discrimination

Multiple Equilibria

Individual Reputation
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Multiple Equilibria

Individual Reputation
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Statistical Discrimination

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Affirmative Action, Incentives and Stereotype

▶ Does affirmative action destroy incentives, investment in skills, etc.?

▶ Does affirmative action worsen stereotypes of beneficiaries?

▶ Theoretically, it can go either way:

  ▶ since AA makes entry easier, fewer members may invest.
  ▶ under statistical discrimination, if entry is too hard, it may discourage investment.

▶ The effect can only be determined empirically.

▶ Our model illustrates potential positive effect on stereotypes in two senses:

  ▶ the bad equilibrium improves locally (temporary effect).
  ▶ the bad equilibrium is destroyed altogether (permanent effect).

Individual Reputation
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Statistical Discrimination

Group Reputation
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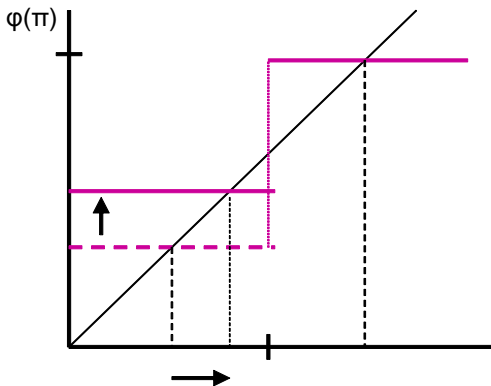○○○○○○○○○○○○○●○

Affirmative Action, Incentives and Stereotype

▶ Suppose A's are in bad equilibrium, W's are in good equilibrium.

▶ If quotas are introduced, employers may be forced to hire a fraction α of A's with unclear test results.

▶ For given α, a A worker invests if

$$\underbrace{(1 - p_q + \alpha p_q)\, w - c}_{\text{qualified payoff}} \;\geq\; \underbrace{\alpha p_u w}_{\text{unqualified payoff}}$$

$$\text{or, } \; c \leq [1 - p_q + \alpha(p_q - p_u)]\, w$$

▶ If $p_q > p_u$ (condition for multiple equilibria), the cost threshold for investment increases with α.

▶ Incentives and stereotype improve in the bad equilibrium.

Individual Reputation
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Group Reputation
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Statistical Discrimination

Case 1: Local Improvement, Temporary Effect

Case 2: Global Improvement, Permanent Effect