Heterogeneity, Selection and Labor Market Disparities

Alessandra Bonfiglioli Gino Gancia

UPF and CREI

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Motivation

- developed countries differ markedly in a number of social and economic indicators
  - inequality
  - labor and total factor productivity
  - human capital
  - firms characteristics and distribution
- proposed explanations:
  - policy distortions
  - culture
- our answer:
  - multiple equilibria sustained by different beliefs on the importance of effort for finding good jobs

Beliefs, Selection and Multiple Equilibria

- key assumptions:
  - ability can be increased investing effort, but effort raises also the variance of the ability distribution
  - firms can screen workers at a cost $\longrightarrow$ screeing profitable if ability is dispersed enough
- complementarity between between effort choice and firms' hiring policy
  - if agents put effort $\longrightarrow$ higher heterogeneity $\longrightarrow$ firms screen workers
  - if firms screen workers $\longrightarrow$ agents find it profitable to put effort

The Model in Brief

- heterogeneous firms and workers *à la* Helpman et al. (2010)
- labor market frictions:
  - search frictions
  - costly screening of workers' ability
- technology:
  - decreasing returns to employed worker
  - output increasing in average ability of employed workers
- firms screen workers only if *ability* is *sufficiently dispersed*
  - more productive firms screen more, hire more able workers, pay higher wages

Effort and Multiple Equilibria

- workers can invest costly effort to improve ability before seeking a job
  - effort raises both mean and variance of ability
- if workers believe that firms will screen,
  they put effort $\longrightarrow$ ability *sufficiently dispersed* $\longrightarrow$ firms screen
- self-sustaining beliefs and screening
- two equilibria: screening vs no screening

Main Results

- with screening (relative to no screening):
  - higher productivity
    - ★ higher ability
    - ★ better workers selection
    - ★ tougher firm selection
  - firm-level outcomes:
    - ★ bigger firms in terms of revenue
    - ★ positive sorting between firms and workers
    - ★ more dispersion
  - higher wage inequality (both between and within)
  - unemployment may be lower

Motivating Evidence: Economic Disparities

- wage inequality and labor productivity:

	College Premium	Var. log wages	GDP/hour
US	1.8	0.44	60.2$
IT	1.51	0.17	45.6$
ES	1.48	0.23	47.5$

- firm-level outcomes:
  - US firms are bigger + higher covariance (size, productivity) (Bartelsman et al., 2013)
  - dispersion: st.dev. ln(revenue) 30% higher in US than IT/ES
  - selection: survival probability at 4 years 10% lower in US than IT
  - US firms value more selecting talented workers (Bloom et al., 2010)

Motivating Evidence: Cultural Disparities

- World Value Survey, respondents who strongly agree that:
  - "hard work brings success"
    USA $\rightarrow$ 26.4%, ITA$\rightarrow$ 14.6%, ESP$\rightarrow$ 12.2%
  - "success is a matter of luck and connections"
    USA $\rightarrow$ 2.3%, ITA $\rightarrow$ 8.9%, ESP $\rightarrow$ 7.8%
  - "competition is good"
    USA $\rightarrow$ 29.6%, ITA $\rightarrow$ 19.2%, ESP $\rightarrow$ 15.6%

Motivating Evidence: Human Capital Disparities

- share of working-age (or 25-34) population with tertiary education (OECD, 2013):
  - USA $\rightarrow$ 42% (43%)
  - ITA $\rightarrow$ 15% (21%)
  - ESP $\rightarrow$ 32% (39%)
- expenditure in tertiary education as a share of GDP (OECD, 2013):
  - USA $\rightarrow$ 2.8%
  - ITA $\rightarrow$ 1%
  - ESP $\rightarrow$ 1.3%
- education outcome: test results (e.g., PISA)
  - USA higher average scores than ITA and ESP
  - USA more dispersed scores than ITA and ESP
  - USA more discipline at school than ITA and ESP

Related Literature

- multiple equilibria based on
  - political preferences:
    - ★ Piketty (1998), Benabou (2000) and Alesina & Angeletos (2005)
  - human capital externalities:
    - ★ Azariadis & Drazen (1990), Galor & Zeira (1993), Hassler & Rodriguez Mora (2000)
  - statistical discrimination:
    - ★ e.g., Coate & Loury (1993)
- allocation of talent and economic performance
  - Acemoglu (1996), Hsieh et al. (2012), Bonfiglioli & Gancia (2014)
- wage inequality with imperfect labor markets and firm heterogeneity
  - Acemoglu (1997), Helpman, Itskhoki & Redding (2008, 2010), Eeckhout & Kircher (2012)

Preferences and Demand

- unite mass of households with size $\bar{L}$ and utility function:

$$U = q + \frac{Q^{\zeta}}{\zeta}, \quad \zeta \in (0,1)$$

  homogeneous goods: Q "advanced", q "residual"

- demand for Q:

$$Q = P^{-\frac{1}{1-\zeta}}$$

  - $P =$ price of the advanced good
  - $p = 1$ price of the residual good (numeraire)

- assume $q > 0$ in eq.

Technology

- both goods are produced with labor
- q requires 1 unit of labor per unit of output and is sold at $p = \underline{w} = 1$
- Q produced by heterogeneous firms with DRS and:
  - fixed entry cost f_e
  - productivity θ drawn from a Pareto: $G(\theta) = 1 - (1/\theta)^z$, $z > 1$
  - fixed production cost f_d
  - exit if profits $\pi < 0$
  - free entry: mass M of entering firms is endogenous
  - all costs expressed in terms of the residual good

Technology and Frictions

- output of firm with θ productivity, h employees of average ability $\bar{a}$:

$$y = \theta h^{\gamma} \bar{a},$$

  - $\gamma \in (0,1)$: span of control
  - a = ability $\sim$ Pareto: $I(a) = 1 - (1/a)^k$, $k > 1$
- firm pays *bn* to *match randomly* with $n \geq h$ workers
  - b will depend on labor market tightness
- *unobservable* ability
  - firm pays $\left[(a^*)^{\delta} - 1\right] c/\delta$ to *screen* out workers with $a < a^*$

$$\bar{a} = \frac{k}{k-1} a^* \quad \text{and} \quad h = n \left(\frac{1}{a^*}\right)^k$$

  - if $k < 1/\gamma$, then y increases with screening:

$$y = \theta \frac{k}{k-1} (a^*)^{1-\gamma k} n^{\gamma}$$

Firm's Problem

- wage bargaining as in Stole and Zwiebel (1996):
  - firm's share of revenues $= 1/(1+\gamma)$
- firm solves

$$\pi(\theta) = \max_{n>0, a^* \geq 1} \left\{ \frac{r(\theta)}{1+\gamma} - bn - c\frac{(a^*)^{\delta} - 1}{\delta} - f_d \right\}$$

  - with $r(\theta) = Q^{-(1-\zeta)}\theta n^{\gamma} k (a^*)^{1-\gamma k} / (k-1)$
  - f.o.c.:

$$\begin{aligned} n &: \quad \frac{\gamma}{1+\gamma} r(\theta) = bn(\theta) \\ a^* &: \quad \frac{1-\gamma k}{1+\gamma} r(\theta) = c\left(a^*(\theta)\right)^{\delta} \text{ for } k < 1/\gamma \end{aligned}$$

  - more productive firms sample more workers: n increasing in θ
  - more productive firms screen harder: a^* increasing in θ

Firm-Level Outcomes

- profits of firms with θ productivity become:

$$\pi(\theta) = \frac{\Gamma}{1+\gamma} r(\theta) - f$$

  - with $\Gamma \equiv 1 - \gamma - \mathbb{I}_s \frac{1-\gamma k}{\delta} > 0$ and $f = f_d - \mathbb{I}_s c/\delta$
  - indicator $\mathbb{I}_s = 1$ if $a^* > 1$, zero otherwise

- revenues are increasing in $\theta \longrightarrow$ firms exit if $\theta < \theta^*$
- wages and employment of firms with θ productivity become:

$$w(\theta) = b a^*(\theta)^k \quad \text{and} \quad h(\theta) = \frac{\gamma c a^*(\theta)^{\delta-k}}{(1-\gamma k) b}$$

  - also w and h increasing in θ (assume $\delta > k$)

Advanced Sector Equilibrium

- find the equilibrium values of θ^*, Q and M by imposing
  - zero-profit cutoff

$$\pi(\theta^*) = \frac{\Gamma}{1+\gamma} r(\theta^*) - f = 0$$

  - free-entry

$$f_e = \int_{\theta^*}^{\infty} \pi(\theta) \, \mathrm{d}G(\theta)$$

  - product market clearing

$$PQ = M \int_{\theta^*}^{\infty} r(\theta) \, \mathrm{d}G(\theta)$$

Labor Market Equilibrium and Ability Distribution

- ability distribution depends on workers' effort choice:
  - effort, $\mathbb{I}_\eta \in \{0, 1\}$, costs η and raises mean and variance of a:

$$k = \begin{cases} k_0 \to \infty & \text{if } \mathbb{I}_\eta = 0 \\ k_1 < 1/\gamma & \text{if } \mathbb{I}_\eta = 1 \end{cases}$$

    - ★ individual choice unobservable, k observed by firms
- occupational choice:

$$1 = \frac{N}{L}\frac{wh}{n} - \mathbb{I}_\eta \eta$$

  - employment in the residual sector vs job seeking in the advanced sector
- search cost b increases with tightness, N/L:

$$b = \alpha \left(\frac{N}{L}\right)^\beta, \quad \alpha > 1 + \eta, \ \beta > 0$$

  - with $N =$ sampled and $L =$ job-seeking workers

Multiple Equilibria

- there exist two pure-strategy equilibria with $\mathbb{I}_\eta = \mathbb{I}_s$
  1. high effort + screening
     - ★ if workers put effort $\longrightarrow k_1 < 1/\gamma \longrightarrow$ firms screen
     - ★ if firms screen $\longrightarrow$ workers invest
       (or else be unemployed since $1 < a^*$)
  2. low effort + no screening
     - ★ if workers do not invest $\longrightarrow k_0 \longrightarrow \infty \longrightarrow$ firms do not screen
     - ★ if firms do not screen $\longrightarrow$ workers do not invest
       (or else they would face equal job opportunities, but waste the cost η)

  - the result generalizes to any $k_0 > 1/\gamma$, under parameter restrictions

Comparing Equilibria: Unemployment

- unemployment rate

$$u = 1 - \frac{N}{L}\frac{H}{N}$$

- in the screening equilibrium:
  - frictional unemployment (N/L) is lower (to compensate workers for η)
  - but screening generates unemployment ($H/N < 1$)
  - overall the unemployment rate is lower if

$$(1+\eta)^{\frac{1}{1+\beta}} > \frac{z\Gamma_1 - 1 - k_1/\delta}{z\Gamma_1 - 1} a^* \left(\theta_1^*\right)^k$$

Comparing Equilibria: Wages

- in the screening equilibrium, wage inequality is higher
  - between the two sectors: "skill premium" $= \bar{w}/1$

$$\frac{\bar{w}_1}{\bar{w}_0} > \frac{w_1\left(\theta_1^*\right)}{b_0} = \frac{b_1 a^*\left(\theta_1^*\right)^{k_1}}{b_0} > 1$$

    with $\bar{w}$ = average wage in the advanced sector
  - within the advanced sector:

$$SD\left(\log w_1\right) = \frac{k_1}{k_1 + \delta\left(\Gamma_1 z - 1\right)} > 0 = SD\left(\log w_0\right)$$

Comparing Equilibria: Firm Productivity

- in the screening equilibrium, firms are more productive
  - firm selection:

$$\frac{\theta_1^*}{\theta_0^*} = \left(\frac{z\Gamma_0 - 1}{z\Gamma_1 - 1} \frac{f_1}{f_0} \right)^{1/z} > 1$$

    - ★ since $\Gamma_0/\Gamma_1 > f_0/f_1$ (for $a^*(\theta_1^*) > 1$), and hence also $\bar{\theta}_1 > \bar{\theta}_0$
    - ★ intuition: screening makes more productive firms even more profitable $\longrightarrow$ least productive firms must exit
  - higher average ability of all workers

$$\mathbb{E}[a|\mathbb{I}_s = 1] = \frac{k_1}{k_1 - 1} > 1 = \mathbb{E}[a|\mathbb{I}_s = 0].$$

  - workers' selection $\longrightarrow$ higher average ability of hired workers:

$$\mathbb{E}[\bar{a}|\mathbb{I}_s = 1] = \frac{k_1 a^*(\theta_1^*)}{k_1 - 1} \frac{k_1 + \delta(\Gamma_1 z - 1)}{k_1 + \delta(\Gamma_1 z - 1) - 1} > 1$$

Comparing Equilibria: Firm's Revenue and Employment

- in the screening equilibrium:
  - revenues are higher

$$\frac{\bar{r}_1}{\bar{r}_0} = \frac{z\Gamma_0 - 1}{z\Gamma_1 - 1}\frac{f_1}{f_0} > 1$$

    - ★ screening $\longrightarrow$ r steeper in θ + higher $\bar{\theta}$
  - and more dispersed

$$\frac{SD\left(\log r_1\right)}{SD\left(\log r_0\right)} = \frac{\Gamma_0}{\Gamma_1}\frac{f_1}{f_0} > 1$$

  - employment may be higher or lower:

$$\frac{h_1\left(\theta_1^*\right)}{h_0\left(\theta_0^*\right)} = \frac{\Gamma_0}{\Gamma_1}\frac{f_1}{f_0}\frac{b_0}{b_1}a^*\left(\theta_1^*\right)^{-k}$$

    - ★ profitability (+), tightness (-), screening (-)

Comparing Equilibria: Numerical Example

- data on US (screening eq.) and IT/ES (no-screening eq.)
- parameter set so as to match:
  - unemployment rate of 10% in IT/ES
  - skill premium in IT/ES
  - variance of sales in IT/ES
  - 10% elasticity of wage to firm size
- remaining parameters:
  - $\gamma \in \{0.2, 0.5, 0.8\}$
  - $k \in \{1.1, 1.5, 2\}$
  - here we only report $k = 1.1$

Comparing Equilibria: Numerical Example

		(1)	(2)	(3)	(4)
	Data	Model A		Model B	
γ		0.2	0.8	0.2	0.8
$\Delta\bar{w}$	23%	23.1%	22.3%	11.4%	11.0%
$SD\left(\ln w_1\right)$	0.66	0.098	0.092	0.098	0.092
u_1	5%	9.7%	9.1%	9.5%	9.2%
$\Delta\bar{r}$	150%	9.6%	5.5%	9.6%	5.5%
$\Delta SD\left(\ln r\right)$	30%	8.8%	5.2%	8.8%	5.2%
$\Delta\bar{h}$	50%	-11%	-13.7%	-1.7%	-5%

Note: Δ = % differences between eq. with/without screening

- explain $\sim$ 10-20% of differences in firm/labor-market outcomes
  - does well on wages
  - does not generate enough dispersion and differences in size

Extensions and Robustnes

- unemployment in the residual sector
  - lower unemployment rate in the screening equilibrium becomes more likely
- costly entry in the advanced sector labor market
  - e.g., minimum education attainment costs ε
  - allows to obain skill premium + lower unemployment in the advanced sector
- search cost as a function of the unemployment rate
  - discarded sampled workers are hirable:
    $\longrightarrow$ lower search cost in the screening equilibrium:
    $b = \alpha (H/L)^{\beta} < \alpha (N/L)^{\beta}$
    $\longrightarrow$ lower unemployment in the screening equilibrium

Conclusions

- a model to explain the divergence in a set of labor market outcomes:
  - multiple equilibria sustained by beliefs on the value of effort and ability
  - investment in effort raises both mean and variance of ability
  - complementarity between hiring policy and workers' effort
  - two equilibria:
    - ★ screening+high effort vs no screening-low effort
    - ★ different labor market outcomes and firms distribution
- can explain around 10-20% of the differences in firm/labor-market outcomes
- policy implications: how to make the screening equilibrium more likely?
- further extensions:
  - learning dynamics and equilibrium selection
  - shocks and cyclical properties across different equilibria
  - endogenous degree of frictions